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ENGINEERING AND
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Engineering and Mining Journal

Engineering and Mining Journal was founded in 1866 as the *American Journal of Mining*, with George Francis Dawson as Editor. In 1869 the name was changed to *Engineering and Mining Journal.*

Publications which have been absorbed are: 1875, *Coal and Iron Record;* 1877, *The Mining Review* (Denver); 1879, *The Polytechnic Review;* 1902, *Mining and Metallurgy;* 1906, *Mining Magazine;* 1917, *Mining and Engineering World.* The successive editors have been Rossiter W. Raymond, Richard P. Rothwell, Fred Hobart, David T. Day, T. A. Rickard, W. R. Ingalls, J. E. Spurr, and A. W. Allen.

On April 1, 1922, *Engineering and Mining Journal* was consolidated with *Mining and Scientific Press* as *Engineering and Mining Journal-Press.*

The *Mining and Scientific Press* was established in 1860 as the *Scientific Press.* Three years later "Mining" was added to the title. The editors have been Almond D. Hodges, Charles G. Yale, J. F. Halloran, T. A. Rickard (twice), and H. Foster Bain.

On July 1, 1926, the consolidated magazine reverted to its former name, *Engineering and Mining Journal.*

The staff of the *Engineering and Mining Journal* consists of A. W. Allen, Editor; T. A. Rickard, Contributing Editor; E. H. Robie, George J. Young, A. H. Hubbell, and A. B. Parsons, Associate Editors; W. N. P. Reed and H. D. Keiser, Assistant Editors.

Progressive Railroads and the Mineral Industries

THE geological departments maintained by many railroad companies encourage mineral development by investigating resources in the areas served by their lines, and by advice and assistance bring about exploitation and utilization. The primary purpose is to develop tonnage, not only in mineral transported but in the increased traffic which inevitably accompanies the growth of communities along their lines. Promotion of this kind has been active in the Western states. The Southern Pacific, Union Pacific, and Santa Fé railroads in particular are making efforts to stimulate mineral development, especially along those parts of their lines which traverse desert areas of little or no agricultural possibilities. If they do not produce mineral, their only "resource" is scenery, and sometimes not much of that. Fortunately, metals and nonmetallic minerals in considerable variety occur in the playas and in the mountain ranges of the Great Basin region. Searles and Owens lakes are examples of valuable saline deposits. The colemanite mines of Furnace Creek, the filtering clays of Ash Meadows, and the Muroc borax deposit are cases in point. Gypsum deposits near Arden and in Imperial County are important sources of supply. Feldspar, quartz, limestone, pottery clay, and diatomite are mined from numerous deposits.

Important progress is being made in the Southwest in the exploitation of a variety of industrial minerals. One element in the situation is the possibility of too many producers and the decline of prices as a result of keen competition. Geological departments and chambers of commerce can render a substantial aid to such industries by emphasizing the necessity of ascertaining with reasonable assurance that the product can be profitably marketed before capital is invested in the development and equipment of new properties.

Scholarly Business and Businesslike Scholarship

THE growing appreciation of the interdependence of scholarship and business was emphasized by Dr. Max Mason, president of Chicago University, at a business-paper convention there recently. And the yardstick of success in this eminently logical union, to determine if scholarship is real and if business is being efficiently and rightfully conducted, is—the unit of human happiness. Somewhere, somehow, the result of every scholar's activity, or of every business man's venture, is increased human happiness, we are reminded, or he is a failure. It may be ten years, it may be fifty years, it may be a century. That we are to profit eventually is inevitable, says Doctor Mason, who contends that with the American business man of today lies the cultural and social future, as well as the industrial future, of the country. It is rightfully averred that the successful men who are directing the affairs of great businesses get more thrill from humanitarian results than from successful commercial performance.

Culture, we are reminded by Doctor Mason, is a definite result of a temper of mind—an innate or educated sense of the fitness of things—a byproduct of efficient and sensible living, not something to be acquired by absorption. Beauty and efficiency (and, we would add, simplicity) are synonymous: nothing is so beautiful as an efficient process. The ideal combination is utilitarianism and beauty. One is reminded of the pseudo-cultural trait that would erect a homely building faced with gingerbread decorations—a Queen Anne front with a Mary Ann back, as it were.

Real scholarship may be gaged by the degree of open-mindedness shown toward the truth, and a technical ability to unearth and discern the verities. Scholarship for a purpose, not for ornamentation, is the goal of the progressive universities of today. If the ability is there, we are reminded, delight and ornamentation form a joint complementary sequel, even as culture is a byproduct of rational and sensible living. To those of Doctor Mason's

mind, the ideal university comprises a group of earnest and able men provided with physical facilities that will enable them to solve problems. Educational advantages among the rank and file include the right to participate in the solution of such problems.

The kernel of Doctor Mason's address, however, may be found in his conclusion that "we human beings have an advantage over every other type of animal. We can think, we can imagine, we can run through a set of pretense experiences in imagination and get an answer to a problem, very often, without the method of trial and error." This ability, this mark of supreme scholarship, we would add, distinguishes the scientist from the ordinary worker. It indicates what should be encouraged. If business would back individual talent in addition to subsidizing group research, the financial result would be quicker and surer.

The investigator who can correctly visualize and anticipate the results of a series of pretense experiences is worth his weight in gold.

Are American Principles and Structures Unsound?

ALTHOUGH the remainder of the world has observed American industrial advance in recent years with amazement, the underlying sentiment has shown in many instances a wish that was father to the thought—the collapse of the economic and material structures on which a great prosperity had been built. The word "thought" has been used advisedly, but in a sense excluding the elements of study and scientific research. The vast amount of co-ordinated labor essential to the accumulation of per-capita wealth is invariably overlooked, and an explanatory gesture infers that richness of national resources is almost entirely responsible. For the peace and happiness of the world, the best that can be hoped is that American methods be investigated with an open mind, and copied wherever suitable. A condemnation of policies and practices, after a sketchy analysis, will do infinite harm and delay progress in those countries where prosperity would automatically encourage an attitude of friendliness to the outside world.

One factor in American prosperity—installment buying—has been the object of widespread disapproval and skepticism in other countries, and many have been the hints and prophecies that, on this account, the United States was approaching a condition of economic instability. It is true that the practice grew at such an amazing rate, and its success was so patent, that no attention was paid to its fundamental *raison d'être,* or to a study of general economic causes and effects in this connection. This research has been carried out during the past year and a half by Prof. E. R. A. Seligman, of Columbia University, whose work on "The Economics of Installment Selling," in two volumes, has recently been published. In consequence, the subject has been clarified, and ample justification is shown to exist for the adoption of the principle and for its extension even beyond its present accepted scope. On second thought, one must admit that it is as logical to finance distribution as to finance production; or, as Professor Seligman indicates: "installment credit is beginning to do for the consumer what . . . the commercial banking system has done for the producer." The opportunities for systematizing and promoting distribution of products on the installment plan should be investigated by all industries in which technical methods have been brought to a high pitch of efficiency and economy, and output increased commensurately, but where banking facilities have not been utilized adequately to facilitate the disposal and marketing of raw or manufactured products.

A second American institution is said to be top-heavy —it presents a material, not an economic problem, however. A distinguished European architect avers that the American skyscraper is doomed to disintegration and collapse in forty years or so. In respect to this typically American development, no emulation abroad is expected: Tall buildings were first erected by necessity and not from choice; but, like installment buying, they have proved remarkably efficient and economical, so that choice is now usually the deciding factor, which has led to the most significant developments in industrial architecture and civic grandeur yet achieved.

Progress is impossible without initiative and the abandonment of age-old practices. The building of skyscrapers of a standard vertical-wall type led promptly to modifications and improvements that have served as an endorsement of the skyscraper principle. As for their stability and power to withstand the ravages of time, one can only point to the increasing quantities of non-ferrous metals used in their construction. It is probable that metals such as copper and chromium may be used in the future to a considerable extent in the manufacture of ordinary structural steel, as security against rust. In such event, the non-ferrous metal industries would be able to contribute in larger measure to an ideal of stability and permanence.

Opportunity for Copper in England

THOUGH the German demand for copper has recently expanded greatly, and though large plans for electrical development in France and Italy have received considerable publicity, Great Britain remains one of the most important potential markets for copper in electrical manufactures. Censuses carried out in 1924 and 1925 show that industries were only 48 per cent electrified in Great Britain, compared with 66 per cent in Germany, and 73 per cent in the United States. The total primary power installed was found to be 16,500,000 hp. in Great Britain, 17,-657,000 in Germany, and 35,773,000 hp. in the United States, so that, to electrify the industries in Great Britain to the extent that obtains in the United States, about 5,500,000 hp. of primary power engines would have to be replaced by electric motors. Particularly backward in electrification is the textile industry in England, which is only 26 per cent electrified, compared with 68 per cent in the United States.

To generate and utilize five million horsepower will require much copper, depending in amount upon the distance the power is to be transmitted, the form of equipment used and the capacity of individual units. World competition will no doubt force British industry to modernize its power equipment, but the change is likely to come slowly. Opposition to change of any sort, characteristic of the Old World, must be overcome. Comparatively rapid progress is being made, however. Large electric power stations, utilizing up-to-date methods of coal treatment and combustion, are being built; and co-ordination of sources of electrical supply will in time be an accomplished fact.

Geophysics and Publicity

GEOPHYSICAL METHODS of prospecting, interest in which is at an unprecedented height in the mining world today, are being carefully studied. The U. S. Bureau of Mines has been investigating them, and expects soon to issue a bulletin covering its work on the subject. The American Institute of Mining and Metallurgical Engineers has arranged a symposium on geophysics for the forthcoming February meeting in New York. *Engineering and Mining Journal,* moreover, expects to place before its readers, from time to time as it has done in the past, papers on geophysical prospecting, written by physicists who are authorities on the subject.

Abroad, a similar interest is evident. In Australia, an exhaustive test of geophysical prospecting methods is to be undertaken. To defray the cost, the commonwealth government has arranged with the British Empire Marketing Board to share equally in an appropriation of £32,000. The government geologist for New South Wales, Mr. E. C. Andrews, is at present in the United States gathering preliminary data for the work. This program has the support of the Australasian Institute of Mining and Metallurgy.

Such widespread study is sure to produce good results. No one geophysical method will be found to be the best for general application—the conditions are too variable—but it is not unlikely that some of the methods now in use or their modifications can be eliminated and practice thereby simplified. However, the results obtained by any one method are, after all is said and done, the best criterion of that method. Had the very considerable amount of geophysical work already done received adequate publicity, some of the investigations now in progress or planned might be proved unnecessary. A large initial fund of fact is the best insurance against waste in research.

Development of many an art has been retarded by the policy of secrecy pursued by its sponsors. With a free exchange of information, success in general is soonest reached. Geophysical prospecting should be no exception. But the question has been asked: How can a mining company allow the publication of the results of a geophysical survey made on its property? The implication is that such a course would be against its interests. It is true that publicity at times may be ill-advised—for instance, in the case of the wild-catting exploration of an oil company; or the field work of an operator on unstaked ground; or if the market value of the company's stock would be affected thereby. But in many of such instances the reason for secrecy may have only momentary weight, and the publication of data may eventually prove desirable in the interests of all concerned.

Publicity would certainly benefit the geophysical exploration company if it had accomplished something meritorious; and refusal of a client to admit that a survey had been successful would seem to indicate an ungenerous if not an unfair attitude. Here it should be borne in mind that time is needed to check geophysical data with underground work or drilling. But if information gained by the mining company through other channels would serve to check such data, it seems ultra-conservative, to say the least, to leave the exploration company guessing as to whether or no it had been of service. On the other hand, if a clause providing for publicity is included in a contract covering geophysical work, it should be so worded as to prevent the surveying company from advertising the discovery of indications of ore, or the existence of conductors, until some check has been established. Otherwise, it is believed that publicity may result in unwarranted sensationalism.

Alaska Roads and the Budget

FOR cutting down appropriations, the Administration has its official axeman—the Director General of the Budget. The incumbent of this office has won for himself a reputation for ruthlessness since he undertook his duties several years ago, which is not surprising. Axemen, headsmen, and the like are not chosen for their thoughtfulness. The ability to think, indeed, is the last attribute required of them. An axeman must not think—it may spoil his stroke and hurt his work. He cuts under orders merely for the sake of cutting.

The present Director General has proved a capable axeman. He cuts clean and thinks but little. This is well exemplified in his treatment of the appropriation sought for building roads in Alaska. The need for roads in that territory is great—not highways to enable tourists to get a glimpse of Alaskan scenery, but branch roads up into the hills connecting the mining districts with the main highways already built. Branch roads such as these must be provided if the mining districts are to be developed to yield minerals and to furnish a market for the products of an agricultural industry as yet struggling to survive. To construct such roads in 1928, the Alaska Roads Commission has asked of Congress $2,000,000, a modest request, indeed, when the size of the territory is considered. For the Director General, here was food for thought. Here a less worthy axeman of the Budget might have faltered. But our hero did not weaken. Thoughtlessly, unthinkingly, efficiently, as becomes a director general of a budget, he swung his axe and with one stroke cut the amount asked for to a mere half million dollars. Had he thought a moment he might have hesitated; the idea might have suggested itself that with more roads Alaska might become self-sustaining, by the increased revenue from taxation.

Today, it should be understood, the mining industry in Alaska finds itself in a state of transition. The rich bonanza placers are beginning to show exhaustion. Eyes are turned toward lode mining, which is scarcely under way. For the latter, adequate transportation is a prime necessity. It must be provided for transporting into the hills the heavy machinery, supplies, and men required in the course of developing a lode property, large or small.

What has been said of highways and their lack of feeder branch roads has also been said repeatedly of the Alaska Railroad since it was built. It, too, lacks feeders reaching down to it from the mining districts in the hills along the route. Because of this it suffers from a lack of the tonnage which would otherwise come from the mines that would be developed.

More money should be spent in providing roads within the territory. A much larger appropriation might have been requested, with propriety. The Director General of the Budget has done his cutting. Now let Congress restore the amputated parts. The proper subcommittee has already held a hearing on this appropriation. When the matter finally comes before the House, and, later, when it is considered by the Senate, it is hoped that the amount originally sought by the Alaska Roads Commission will be granted in its entirety.

Mining Men of Note

CHARLES F. WILLIAMS

District Mining Engineer, U. S. Geological Survey
Miami, Oklahoma

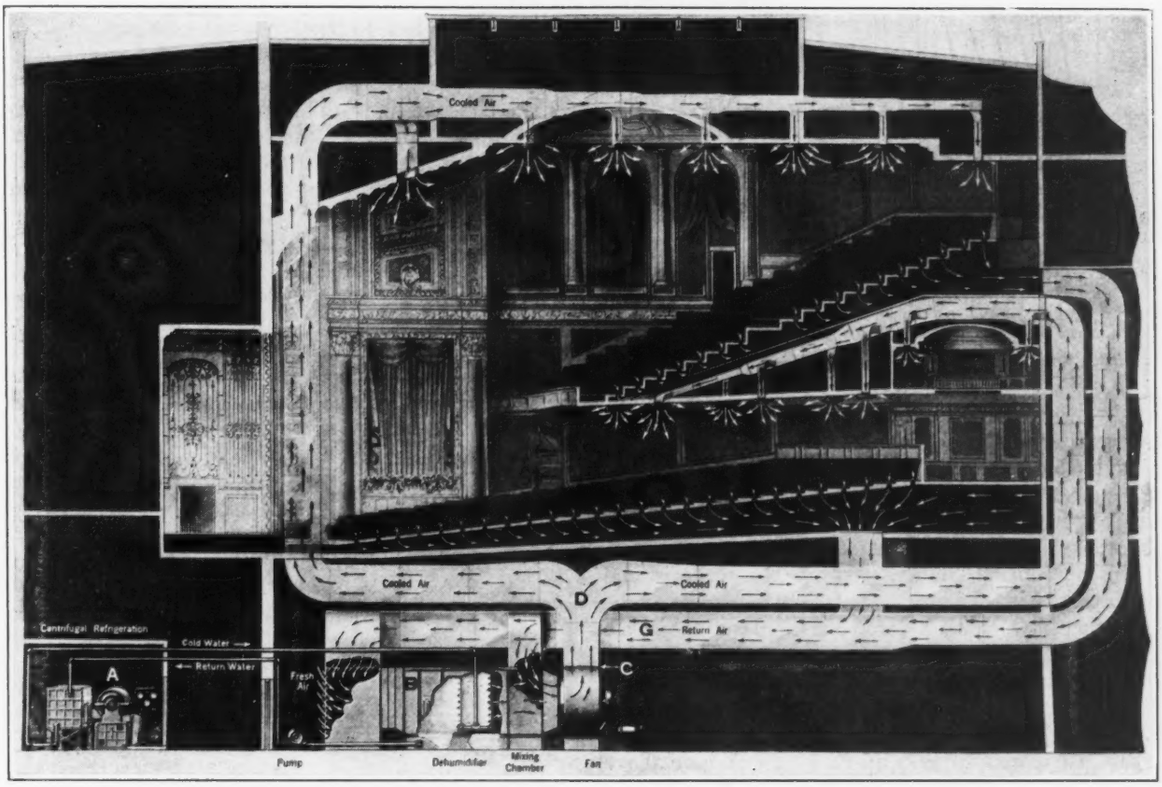
THE United States government, as guardian for 65 restricted Quapaw Indians and their heirs, has under its jurisdiction in the Oklahoma section of the Tri-State zinc-lead district a considerable part of the most productive area in this mining field. Royalties totaling $1,500,000 annually are collected for the benefit of the government's wards. During the last fiscal year ended June 30, 27 per cent of the zinc concentrate and 37 per cent of the lead concentrate produced in the district came from mines situated on restricted Indian land; these concentrates represented, in recoverable metallic content, 22 per cent of the total zinc and 6 per cent of the total lead produced in the United States. The government therefore has, by virtue of its guardianship, an important interest in the zinc and lead mining industries of the country. All technical matters pertaining to the leasing of restricted lands, the supervision of the mining and milling operations on these lands, and the checking of the amount of royalties accruing to the Indians, are in charge of Charles F. Williams, mining engineer of the U. S. Geological Survey, whose headquarters are at Miami, Okla. Mr. Williams' position demands, first, co-operation with the Office of Indian Affairs and the Quapaw Indian Agency, close contact with the various branches of the mining profession, considerable legal acumen, and a through knowledge of the mining industry and its economic problems. Second, the work requires a type of man who will command the respect of the many mining interests of the district and inspire the Indian wards of the government, the mining companies, and the general public with confidence in the government's administration of the mineral leasing acts. Since 1924, when he entered the government service, Mr. Williams has ably filled the position of District Mining Supervisor at Miami. His associates at Washington fully recognize that he has performed his duties with exceptional ability, and the department officials there have transferred to him much of the responsibility for the administration of the government's interests in the Tri-State district. Those in the subordinate engineering grades of the service who have had the privilege of serving with Mr. Williams hold him in high regard; his loyalty to the interests he represents, his technical ability and the diplomacy he brings to the treatment of the many problems with which he is daily confronted have been to them an inspiration and a source of deep satisfaction. Prior to his present work, Mr. Williams was chief engineer for the American Smelting & Refining Company at Santa Eulalia, Chihuahua, and at Charcas, San Luis Potosí, Mexico. Previous to this he was a mining engineer on the staff of the Cananea Consolidated Copper Company in Sonora, and the Great National Mexican Smelting Company in Coahuila. During the World War, Mr. Williams saw strenuous service with the gas and flame troops of the American Expeditionary Forces. He took part in six major offensives and was decorated with the Distinguished Service Cross and the Croix de Guerre for gallantry in action. Mr. Williams was born at Mansfield, Ohio, in 1894. He attended St. John's Military Academy, and received the degree of Bachelor of Science from the New Mexico School of Mines. In 1922 he married Chrystine J. Wagner, of Mansfield.

CHARLES F. WILLIAMS

Commercial Air Conditioning

Possible Application in Mine Operations

By E. G. LAWFORD
Mining Engineer, Rio Tinto, Spain



Sectional perspective drawing of a conditioning plant installed in a theater

THE continually increasing depths, with consequent higher rock temperatures at which mining is being carried on, the vast extent of the workings in present-day mines, and the high humidity of the air as a result of the large volumes of water used for dust allaying, are all factors that increase the difficulty of successfully ventilating mines by fans alone. Conditions in some mines indicate that the question of assisting the fans by the artificial changing of the physical quality of the circulating air is a problem that will have to be faced soon.

Certain industries in America have for a long time been improving the quality of their factory ventilation by artificial cooling of the incoming air, and equipment similar to that used in factories has now been installed in many motion-picture theaters, in New York and elsewhere. During the July heat wave in New York, the temperature rose to 100 deg. dry bulb and over 79 deg. wet bulb—conditions that caused several deaths from heat stroke among the population; yet it was possible to sit through a three-hour performance in the Roxy Theater, New York City, in a temperature which did not exceed 75 deg. dry bulb and 64 deg. wet bulb—a fact that merits the attention of underground operators acquainted with the discomforts and consequently the low output per man in hot mines.

In the consideration of any ventilation problem it is essential to grasp thoroughly the way in which the human mechanism operates for the dissipation of heat. This has been so admirably explained in simple terms by A. Mavrogordato and H. Pirow that I quote verbatim from their paper, as read before the Empire Mining and Metallurgical Congress: "Animals dissipate most of the heat they produce by radiation, convection, conduction, and evaporation. . . . Temperature is controlled as in an incubator, by a thermostat known as 'the heat center.' The heat center is a small area in the brain connected with the blood vessels, respiratory muscles and sweat glands. When the temperature of the blood that bathes it rises, the center responds by dilating the superficial blood vessels, increasing the ventilation of the lungs, and, if this does not do so, bringing the sweat glands into action. Loss of heat by radiation and conduction relates to the temperature of the surrounding air and the rate

at which it is changed. The body loses heat by warming the air in contact with it to its own temperature. As long as the air is below the temperature of the body, the more rapidly it is changed the more rapidly heat is lost.

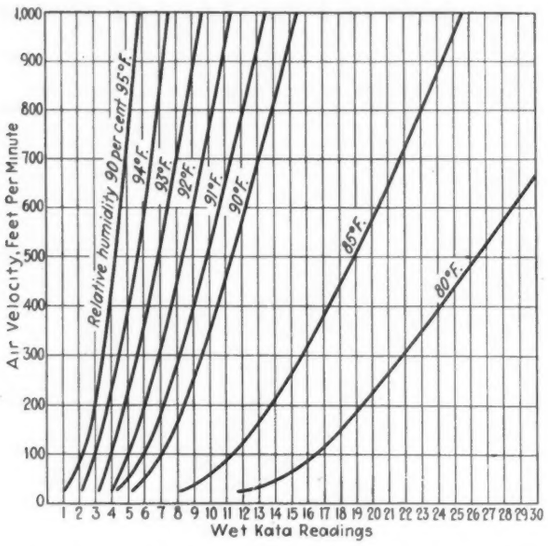


Fig. 1—Chart showing relation of air velocity, temperature, and wet kata at 90 per cent relative humidity

Cooling by sweat is cooling by evaporation. Latent heat, the heat employed in changing a body's state without changing its temperature, is responsible for cooling by evaporation. . . . Evaporation is always going on at the surface of water and is retarded and finally ceases if the vapor is allowed to accumulate in a closed space. When this equilibrium state is reached the space is said to be saturated with vapor. . . . The human body, like any other mass with a damp surface, can evaporate into any air at a temperature below its own, even if that air is saturated with moisture, because the air in immediate contact with the body is warmed and so becomes unsaturated and therefore able to carry more water vapor, and it can also evaporate into air at a temperature above its own as long as that air is unsaturated. Evaporation rate will depend upon the difference between the water content of air saturated at the temperature of the body and the water content in the surrounding air. Leonard Hill calls this the physiological saturation deficit."

It may be interesting to consider, in the light of the above, certain conditions known to exist underground. These conditions are met with in the Witwatersrand mines and could, no doubt, be duplicated on the American continent. They should be scrutinized while bearing in mind that a wet kata[1] cooling factor of 16 may be taken as a desirable cooling rate and a factor of 12 as good enough for fairly efficient manual labor underground.

Underground Conditions in Rand Mines

Dry Bulb	Wet Bulb	Wet Kata	Air Movement Feet per Minute
89.9	88.7	7.2	260
87	86.0	7.4	76
90	89.5	5.3	240
81.8	80.8	8.0	40
79.2	78.5	8.2	still
79.7	77.5	12.2	35
79.7	78.0	12.6	54
76.0	74.2	22.7	375

These figures are interesting because they show clearly that, in the picked hot spots of the first four sets of observations, a splendid air current still fails to give a satisfactory cooling rate. Evaporation from the surface of the body, although it goes on, falls off rapidly long before the body temperature is reached, 86 deg. wet bulb having been established as a critical temperature for white men in *still air*. It will be noticed that the rapid air current of 260 ft. per minute failed to give a reasonable kata cooling factor with the wet-bulb temperature of 88.7. Notice, also, how 78 deg. wet bulb with only 54 ft. per minute air velocity gives a fair kata cooling factor. A clear idea of the relationship between cooling power and wet-bulb temperatures is given by the chart (Fig. 1), which is reproduced from a paper by Mr. J. H. Dobson in the *Journal of the South African Institution of Engineers,* September, 1927.

These results make it evident that when the wet-bulb temperature rises above 85 deg. an increase in the velocity of the air current is of little avail in cooling the worker, and attention must be turned to lowering the wet-bulb temperature if work is to be carried on efficiently. On the Rand today in certain places ice is being transported underground, placed in water tanks, and the ice-cold water discharged by atomizing jets into the upcast air in the ventilation raises: in one instance air enters the raise at a temperature of 88.3 deg. dry bulb and 87.3 deg. wet bulb and leaves at the top 81.6 deg. both dry and wet bulb.

Mine operators who wish to investigate conditions in their own mines may do so without the actual employment of the kata thermometer by the use of formulas.

Writing in the *South African Mining and Engineering Journal* of Sept. 17, 1927, A. L. Egan points out the convenience of being able to ascertain kata cooling factors without using observations made with the kata thermometer, but substituting for those observations of air-current velocity, dry-bulb temperature, and wet-bulb temperature. Modifying Dr. Leonard Hill's formulas to suit English units, Egan uses the following formulas:

$$Kd = (0.15 + 0.0194\sqrt{V})\ (97.5 - T)$$
$$Ke = (16.37 + 4.025V^{0.3})\ (0.813 - P)^{4/3}$$

Wet-kata cooling factors $= Kd + Ke$.

Kd = Dry-kata cooling effect in millicalories per sq. cm. per sec.
V = Velocity of air current in feet per minute.
T = Temperature in deg. F.
Ke = Evaporative kata cooling factor.
P = Pressure of vapor actually present at temperature T in pounds per sq.in.

Obviously, the evaluation of these formulas is a tedious matter, and for this reason Egan constructed the nomograms reproduced here. Their use is extremely simple. Suppose, for example, an operator wishes to compare conditions in two stopes for which he has taken the following observations:

	Stope A	Stope B
Dry-bulb temperature, deg. F.	91	78
Wet-bulb temperature, deg. F.	89	76
Air velocity, feet per minute	40	15

Relative humidity must first be calculated or read from a psychromatic chart.

Dry-bulb 91 deg. F. Wet-bulb 89 deg. F. R.H.—94 per cent
Dry-bulb 78 deg. F. Wet-bulb 76 deg. F. R.H.—90 per cent
First find Kd.
Run a line from 40 on the Vd axis to 91 on the Td axis and where the line cuts the Kd axis reads $Kd = 1.8$.

To find Ke, run a line from the temperature 91 on the Q axis to temperature 91 on the Te axis and mark where this line cuts the 94 per cent humidity line. From this point set off a horizontal line to cut the Te axis and from this latter point set off a line to 40 on the Ve axis. This cuts the Ke axis at 3.9, which is the required evaporative kata factor. The wet-kata cooling factor for stope A is therefore $1.8 + 3.9 = 5.7$.

[1]May be ascertained either by use of the kata thermometer or wet-bulb and dry-bulb thermometers, as will be described presently.

In the case of stope *B*, *Kd* is found to be 4.5 and *Ke* 8.5, giving a wet-kata cooling factor of 13.0.

It will be seen that in these charts is a ready means of approximation which will enable one to express conditions throughout a mine merely by observing, in every working place, these quantities: (*a*) dry-bulb temperature, (*b*) wet-bulb temperature, and (*c*) air velocity.

Research in Air Conditioning

About 23 years ago W. H. Carrier was called upon to undertake research with a view to providing a reasonably constant relative humidity, without undue variations in the dry-bulb temperature, at a lithographing works in Brooklyn; and as a result of his investigations he evolved the atomizer spray principle which the Carrier Engineering Corporation uses with such success today. The principle employed is the refrigeration of water and the spraying of this cold water into the stream of hot air in specially constructed spray chambers. The relative humidity of the air is increased; but, owing to the lowering of the temperature, the absolute moisture content is decreased and, consequently, the physiological saturation deficit is increased, and the air is thus conditioned to give a greatly enhanced cooling effect.

The Carrier conditioning plant consists of two main parts—the refrigerating unit and the spray chamber. The refrigerating unit is composed of an evaporator and condenser constructed as airtight compartments containing an arrangement of brass tubes, set in headers, similar to the familiar marine-type condenser. These are connected to a centrifugal compressor, and to the return pipe for the condensed refrigerant. Operation of the plant is as follows: The evaporator contains the refrigerant dichloromethane, which boils at about 120 deg. F. at normal pressure. When the compressor is started, the pressure on the refrigerant is reduced to about six inches of mercury, absolute, and the liquid boils. The boiling refrigerant abstracts from the water circulating in the nest of tubes the heat necessary for its vaporization. The dichloromethane vapor is drawn into the compressor and delivered to the condenser at a pressure which is still below atmospheric. There it condenses by imparting its latent heat of condensation to water circulating through the condenser tubes. Condensed refrigerant returns automatically to the evaporator tank owing to the difference in pressure between it and the condenser side. All the characteristics of the refrigerant are such that water at 90 to 100 deg. F. will efficiently condense it at pressures below atmospheric.

The compressor is a simple multi-stage centrifugal unit. The only contacts of moving parts in the whole system are the two main shaft bearings, which are ring-oiled and force-fed. No valves are required or used in the compressor. This eliminates one of the chief weak-

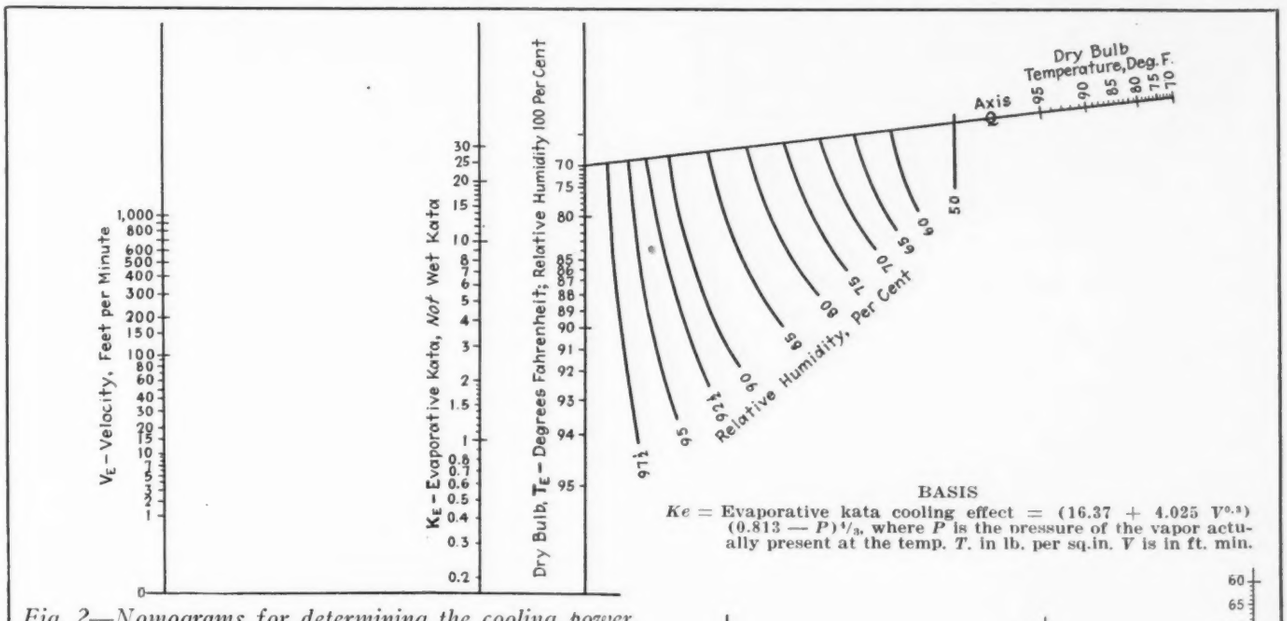
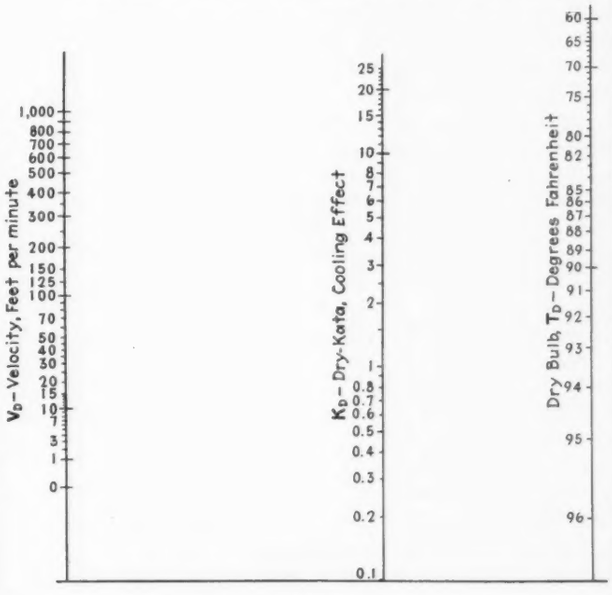

V_E – Velocity, Feet per Minute
K_E – Evaporative Kata, *Not* Wet Kata
Dry Bulb, T_E – Degrees Fahrenheit; Relative Humidity 100 Per Cent
Dry Bulb Temperature, Deg. F.
Axis Q
Relative Humidity, Per Cent

Fig. 2—Nomograms for determining the cooling power of mine air prepared by A. L. Egan

BASIS

Ke = Evaporative kata cooling effect = $(16.37 + 4.025\ V^{0.5})(0.813 - P)^{1/3}$, where *P* is the pressure of the vapor actually present at the temp. *T*. in lb. per sq.in. *V* is in ft. min.



BASIS

Kd = Dry kata cooling effect in millicalories per sq. cm. per second = $(0.15 + 0.0194\sqrt{V})(97.5 - T)$.
V is in feet per minute.
T is in degrees Fahrenheit.

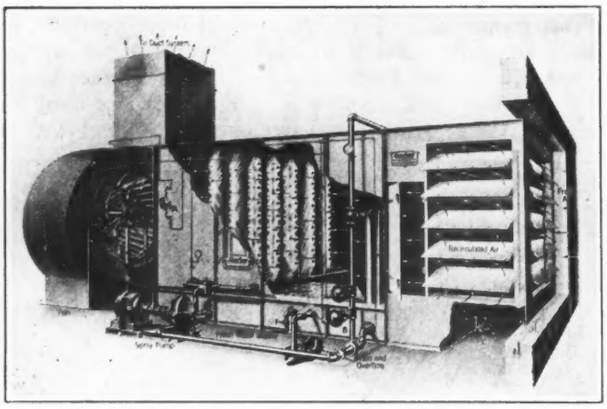
TO USE THE NOMOGRAM

To find *Kd*, run a line from the velocity on the *Vd* axis, to the temperature on the *Td* axis and where the line cuts the *Kd* axis, read off the required value of *Kd*.

To find *Ke*, run a line from the temperature on the Q axis, to the same temperature on the *Te* axis and mark where the line cuts the relative humidity (R. H.) curve; from this mark run a line horizontally across to the *Te* axis and mark it; from this second mark, run a line to the velocity on the *Ve* axis and where it cuts the *Ke* axis read off the required value *Ke*. The "wet kata" effect = *Kd* + *Ke*.

nesses of the positive type of machine, in addition to doing away with wear on piston rings, cylinder, and piston rod. When the compressor is not running, all pressures throughout the system are equalized and remain below atmospheric.

The refrigerated water is pumped to the spray chamber through which air is being drawn by a fan and



Perspective drawing of the spray chamber

discharged into ducts for distribution through the building to be cooled. The spray chamber is of galvanized iron of rigid construction and contains a series of vertical pipes fitted with centrifugal atomizer sprays. These discharge finely divided water into the hot air, resulting in intimate contact over a large surface area and the consequent rapid cooling of the air. Baffle or eliminator plates are arranged in the spray chambers, as shown, to catch particles of entrained water and prevent their entry into the air ducts. This water flow is, of course, a closed circuit, the water used for cooling, together with the water eliminated from the air, falling to the bottom of the chamber and being pumped back through the evaporator or cooler of the refrigerating unit. The degree of cooling is governed by the temperature and the amount of water sprayed into the spray chamber. Likewise, the water circuit of the refrigerant condenser is a closed circuit; but arrangements have to be made to cool this water before its return to the condenser, by the use of cooling towers unless there is a continuous supply of cold water available so that the outgoing water may be discharged outside the building and cool water supplied to the condenser.

The whole plant is nothing more than a heat pump. The heat is pumped, as it were, out of the air and given to the condenser water: in the condenser water it still remains to be dealt with, probably by giving it back to the outside air. This point is of special importance and likely to prove one of the greatest difficulties in the application of such a system to mine ventilation.

Present practice of the Carrier Corporation is to use a 7-deg. range of temperature on both the spray-chamber water and the refrigerant-condenser water: that is to say, a sufficient volume of water is sprayed into the chamber to abstract the requisite amount of heat from the air by raising its own temperature 7 deg., and sufficient water is circulated through the refrigerant-condenser tubes to extract the heat necessary to reduce the vapor to the liquid state by raising the temperature of the condenser water 7 deg. One of the points which will have to be examined, if mining men and refrigeration experts confer, is the reduction of this volume of water by an increased range in temperature. That much larger ranges are practicable is a fact already established.

It is of interest to calculate approximately the requirements in water of a plant to deal with a relatively small quantity of mine air. I will suppose that, in order to continue efficient operations in a certain working place, it is required to reduce the temperature of 14,000 cu.ft. per minute from 88 deg. F., wet bulb to 78 deg. F. wet bulb.

Spray Circuit

Total heat in 1 lb. of air at 88 deg. F., wet bulb, B.t.u.	52.0
Total heat in 1 lb. of air at 78 deg. F., wet bulb, B.t.u.	40.5
Heat to be removed, per lb., B.t.u.	11.5
Approximate weight of 14,000 cu.ft. of air, lb	1,000.0
Total heat to be removed, B.t.u.	11,500.0
Temperature rise of water, deg. F	7.0
Water required 11,500 ÷ 7 = 1,650 lb. or in gal. per minute	220.0

Condenser Circuit

H (the heat taken out of the cooled body) is equal to *C* (the heat transferred to the condenser water) minus *W* (the work done by the refrigeration unit.) Therefore,

$$C = H + W.$$

W involves an allowance of an additional 20 per cent of heat. Therefore, for the condenser circuit, the heat to be removed is 11,500 × 1.20 = B.t.u. 13,800.0

Therefore, circulating water required for condenser circuit in g.p.m. 240.0

As installed for cooling a building, the Carrier plant is inexpensive to operate. The power requirements are given as somewhere about 1 hp. per ton of refrigeration —that is, per 200 B.t.u. removed per minute. Power will be the chief item, because only one man is required for the operation of the plant. The refrigerant is cheap and there is hardly any loss, the process being regenerative. Wear and tear on the centrifugal compressor is negligible: I saw a machine that has been in continuous use for three years in a Texas theater installation, and it was obvious that there was less corrosion and wear than on an impeller handling gritty water or even a rotor of a steam turbine.

The following points should be noted. The Carrier refrigerant is non-poisonous and non-inflammable: moreover, the system operates under a vacuum, so that should any leakage occur, air could enter the refrigerating unit, but the vaporized refrigerant could not escape into the mine.

Furthermore, the plant is extremely compact, so that the amount of excavation would not be excessive: a unit of 150 tons, refrigeration capacity requires some 21 ft. x 11 ft. x 6 ft. height for the refrigerator unit and the spray chamber would occupy some 13 ft. x 12 ft. x 10 ft. The system as applied to buildings is susceptible of delicate automatic control, so that a constant wet-bulb temperature is obtained.

The Carrier plant differs materially, in these respects, from those of other manufacturers of refrigerating machinery who use carbon dioxide or ammonia. In the latter types the refrigerant, under a considerable pressure, circulates through a nest of tubes surrounded by the water to be cooled. Heat extracted from the water vaporizes the refrigerant, which is then compressed in tubes of annular cross-section at a pressure sufficient to liquefy the refrigerant at the temperature of the condenser water that circulates in a compartment of the annular tubes. This pressure is from 1,000 to 1,600 lb. per square inch, depending on the temperature of the condenser water, in the use of carbon dioxide, and 180 to 185 lb. in the use of ammonia. These positive pressures imply the escape into the air of the refrigerant if a leak develops, and involve the use of bulky reciprocating compressors which would add to the excavation necessary. There is considerable objection to a heavy escape of carbon dioxide, and a leakage of ammonia would prove dis-

astrous. Ammonia is the more satisfactory refrigerant, because the condensation of carbon dioxide with water at temperatures above 86 deg. F. demands a larger and more powerful plant.

The entire subject has been so little considered that this class of equipment must be included in any general discussion which may take place between mining and air conditioning engineers. In fact, the only existing plant, used for mine cooling—that of the Morro Velho mine—in Brazil—is of this type. It is, of course, located on surface; but conditions there are exceptional in that the walls of the workings are dry. Consequently, conditioned air can be sent down from the surface and passed through the workings to the hottest places without the absorption of excessive moisture and consequent loss of its satisfactory physiological saturation deficit. This installation does lose in efficiency by its surface situation, because the conditioned air is heated by adiabatic compression in the shaft, but no management could accept the risk of an escape of ammonia underground.

Nevertheless, the possibility of using this type of plant to cool brine solutions on surface and apply the cooled solution to the air at the required point underground will be a factor in any discussion of the general problem.

Possible Application to Mining

The use of such a plant for the conditioning of mine air is a very different problem from that in cooling theaters and factories. In the latter the area to which refrigerated air is to be supplied is small; it is located at the surface, and the cooling of the condenser water presents no problem. The factory is permanent. In the mine, on the other hand, the individual working place where the conditions have to be ameliorated is in a continually changing location. As the face advances and the block is ultimately worked out, its place as a source of tonnage is taken by some other block of ground in a different area of the mine.

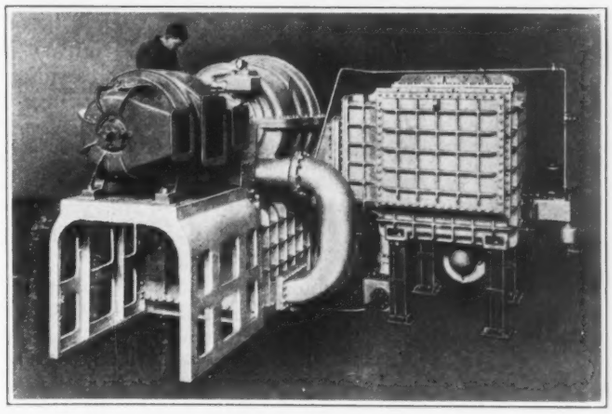
Nevertheless, the mining industry, in conjunction with the manufacturers who serve it, have solved many difficult problems before, and I do not see any reason why, if adequate contact were established between the mining and the air-conditioning technicians, important developments might not take place. It seems to me that their investigations would lead to consideration of the problem of separating the refrigerating plant from the spray chamber and conveying the cold water in a lagged pipe line. Such an installation would help materially to solve the question of the supply of condenser water, because the refrigerating unit could then be located near the main sump so that the heat extracted from the air would be discharged directly into the rising main. Spray chambers would be located at various points in the closest possible proximity to the working places where conditioned air was necessary; and in all probability would be movable, so that the air should lose its low-bulb temperature only in doing useful work in cooling the men at the faces and not absorbing both heat and moisture during its long passage through the mine, as would happen if attempt were made to lay out the plant in imitation of surface practice.

Manufacturers interested in the subject might be asked to investigate the absolute minimum water requirements for both spray-chamber and condenser circuits by undertaking research into possible increases of the temperature-rise range now in vogue. At present the installation of an air refrigerating plant to give fair results with the enormous length of lagged pipe line and heavy additional pumping equipment would entail heavy expenses; but up to the present there has been little direct contact between the miner and the ventilating engineer. The object of these notes is to call the attention of both to an investigation which, it is more than possible, might be to their mutual advantage. Furthermore, until a plant is actually in operation, the reduction of working costs and the increased labor efficiency and decreased accident rates cannot be finally judged.

Air-conditioning plants located underground received due consideration in the exhaustive review of ventilating appliances which was given by Dr. J. H. Dobson in his address to the South African Institution of Engineers which is reported in the journal of that society for September, 1927. Following the same line of reasoning as myself, he says, "The quantity of water available (where concentrated cooling is required) for the condenser cooling requirements, and thereafter pumped to the surface to act as carrier for the B.t.u. inevitably associated with any cooling medium used, puts a limiting factor to what may be done to create cooling B.t.u. underground. Assuming the necessary amount of cooling water available underground, refrigeration will probably provide B.t.u. at much less cost than any other method." This is a significant statement when it is considered that Dr. Dobson in his speech reviewed the following methods of introducing B.t.u. of refrigeration:

1. Increased air circulation.
2. Refrigeration of air at surface.
3. Cooling by compressed air.
4. Cooling by liquid air.
5. Refrigeration plants placed on surface and cold water sent underground.
6. Direct cooling of the underground worker.

Lack of sufficient water underground may well account for the fact that underground refrigeration plants have not so far been tried on the Rand. Operators are likely to think that, in this particular problem, the rejection of a method on the Rand bars it from consideration. There are doubtless many excessively hot mines which are pumping abundant water from their lowest levels. In such mines, where conditions warrant the refrigeration of air, a cooling plant should be entirely feasible.



Sectional perspective drawing showing the refrigerating unit

The possibility of condensing the refrigerant by water and cooling the water by pumping it only a certain distance, then releasing it through atomizer spray nozzles into the upcast air, should also be considered. This heat

interchanger would be so placed that the heated air would go directly to the surface. Accordingly, this would not affect any working places. It has been suggested that a spray chamber, much like that used for cooling the air, could be placed in some upper level. Condenser water would be pumped into this chamber and sprayed into the upcast air, which would then pass directly to the upcast shaft. The upcast air would become still further humidified and the condenser water would be returned at a temperature equal to that of the upcast air at the exit side of the spray chamber. It is needless to say that this part of the plant must be situated at a point in the upcast above any to which permanent access would be required, as the conditions on the discharge side of the spray chamber would be intolerable. This plan seems to offer possibilities in the case of dry mines that are not pumping sufficient water to surface to take care of the refrigerant condenser water.

Supposing that in the small unit outlined above, this method was adopted, and the condenser water was pumped 3,000 ft.: provision would have to be made for 200 hp. Obviously, this is a heavy expense, but is one which may be susceptible of reduction if larger temperature ranges with correspondingly diminished quantities of water are used.

I am indebted to W. H. Carrier, president of the Carrier Engineering Corporation, and to D. C. Lindsay, research physicist, for the information concerning the Carrier installation and for the photographs used to illustrate this article. Many other sources of information have been used in compiling these notes. I refer particularly to Neville Moss's "Gases, Dust and Heat in Mines," the *Journal of the South African Institution of Engineers,* and various bulletins of the Institution of Mining and Metallurgy.

Peruvian Mining Industry Expanding

Production Increased 24 Per Cent in 1926

THE value of Peru's mineral production in 1926 increased 24 per cent over that for the preceding year, a significant gain when it is considered that the economic condition of the world's metal markets was less favorable than in 1925, says Consul George A. Makinson, in *Commerce Reports.* With the exception of vanadium and gold, all of the metals mined in Peru experienced a sensible price decline. The value of Peruvian mineral production—a term understood as the value of that part of the total extraction concentrated or smelted for exportation or domestic consumption — amounted to £22,453,627, an increase of £4,392,845 over the figure for 1925. In this connection it is well to bear in mind that mineral exports are tabulated by the customs authorities in Peruvian pounds. The exchange value of the Peruvian pound was considerably lower in 1926 than in 1925, averaging $4 in 1925 and $3.72 in 1926.

A weight increase of 19.7 per cent, in contrast to the value increase of 24 per cent, is revealed by the following table:

Mineral Production of Peru

Product	1925	1926	Product	1925	1926
Metallic minerals	Kilos	Kilos	Quarry products	Kilos	Kilos
Gold	3,604	3,740	Quartzite	21,861,000	19,255,000
Silver	653,646	669,671	Limestone	74,000,000	77,000,000
Copper	36,844,210	42,510,952.	Lime, live or dead	5,330,000	5,544,200
Lead	16,573,764	20,541,094	Cement	11,278,000	29,295,000
Zinc	14,417,654	21,629,023	Gypsum	14,644,000	16,323,460
Vanadium	245,829	858,327			
Antimony	17,020	99,004			
Arsenic	119,287	.....			
Tungsten	5,439	.....			

Gold experienced an appreciable decline in 1926. Of that produced, 48 per cent was exported in the copper bars produced in the American-owned smelter at La Oroya, 27 per cent was contained in concentrates, and 22 per cent was exported in the form of gold bars with silver content. The remainder was sold to the national mint.

Only two developments of any importance in connection with gold mining occurred in 1926. The American company at Santo Domingo, in southern Peru, closed its mines and offices and another American company constructed a new concentration and cyaniding plant at Pataz in northern Peru. The new metallurgical plant erected by this company consists of a differential flotation plant from which lead concentrates with a high silver content (600 oz. per ton) and pyritic concentrates with gold values are obtained. These latter are treated in an adjoining cyanide plant which began to function late in 1926 and which is yielding precipitates of high value in fine gold.

Peru is still the world's third largest silver producer, although pressed by Canada. Peru established a new high record in 1926. The Morococha district is now the scene of considerable development of lead-silver ores and is largely responsible for the gain of last year. Approximately 70 per cent of the 1926 silver exports left the country as contents of copper bars, 22.5 per cent went out in the form of concentrates, and the balance in ores.

El Sindicato Explotador de Sacracancha is now installing a concentrating plant at its mines which is understood to be capable of treating 120 tons of silver-lead-zinc ores per day. An American copper company also began extensive experimental work at its new plant at Pacos de Tinyahuarco.

Peru continues to hold eighth place in the world's copper production.

The American mines at Morococha record an increase of nearly 5,000 tons in production owing to the absence of trouble with the pumps experienced in 1925. The American concentrating plant erected at Shorey began to function—the smelter was blown in early in 1927. The Armistad concentrating plant was reopened in June, 1926, and has since been handling low-grade ore with marked success. It has a capacity for 400 tons daily, and during the year treated 53,500 tons of ore averaging 3.77 per cent copper and 3.7 oz. per ton of silver.

In 1926 the selective flotation process was used on lead ores for the first time. This plant was at Casapalca, in the central zone, and was responsible for 35 per cent of all the lead exported from this country. A similar plant is now under construction at Pataz and the establishment of several others is being considered.

The 1926 production of vanadium has been exceeded only once in the country's history. Heretofore, Peru has been the world's largest producer of this metal. Owing to the expanding production of British Africa, however, Peru has now dropped to second place. All of the metal produced in Peru comes from the American-owned mines at Mina Ragra, near Cerro de Pasco.

During 1926 the Peruvian mining industry employed 28,592 persons, of whom 25,571 were miners or laborers and 3,021 were paid on a monthly basis. Each laborer or miner worked on an average 320 eight-hour shifts, at an average wage of $0.95 per shift, slightly more than the corresponding rate for the preceding year. The monthly salary of employees averaged about $57. The payroll for the year totaled £2,627,931, the cost of labor representing 11.7 per cent of the cost of production.

Geologic Control of Mine Operations

By J. H. FARRELL
San Francisco

THE first thought on the subject of this paper which occurs to anyone familiar with mining in the West is that geologic control is lacking to a marked degree, although there are striking exceptions. Several very definite reasons are apparent for this condition, and some of them are good ones. In part they are covered by a paper summarized in *Engineering and Mining Journal-Press* of Feb. 6, 1926. ("Economic Geology and the Mining Industry." By Dr. H. C. Boydell. P. 259.) However, a few practical aspects of the matter have not been discussed, and can be stated only at some length. To do this it is necessary to refer first to early mining in the United States, especially in the West, for although some work was going on in Colonial days in the Eastern seaboard states, the great growth of the industry has come since the middle of the last century, under the initial stimulus of the discovery of gold in California and the opening of the Lake Superior region about the same time.

Mexico had seen several centuries of mine development, but the country to the north was practically unexplored and undeveloped, in spite of the fact that the existence of copper on the south shore of Lake Superior had been reported by the first French explorers. The result was that the pioneers found outcrops of iron and copper in Michigan on a scale unknown elsewhere in the world in that day; their chief problems were those of mining and obtaining transportation for their product. The practical miner who could get results under primitive conditions was the man of the hour, and he dominated field operations for many years. In California, Nevada, and Arizona equal importance was attached to results, without much regard for technical methods, even when the application of processes well known in Europe would have assured much better results. It is only necessary to read accounts of some of the early mine and mill operations to realize the truth of this. I have known several mine superintendents who regarded a surveyor with tolerance, as a rather useless addition to the force.

IT IS NOT surprising that the practical side of mining was emphasized at the expense of scientific methods, and that this condition prevailed until changes were forced by absolute necessity; this has been the rule in most industrial development in the past, and still prevails in many fields. The German nation, by properly combining science and industry, made a tremendous advance over old conservative ideas of letting necessity compel progress, and came near to dominating the world in consequence.

With the growth of engineering schools in this country, a large number of technically educated men were made available, and they were attracted to the mining field by the glamorous tales of pioneer days. But they had to fight for recognition from the men of practical training who controlled operations. Gradually the technically trained men proved their worth and superseded the practical miners in positions of authority. The change was not altogether for the better, particularly in the field of exploration work, because no amount of scientific education will compensate for a lack of the keen judgment of many of the "old-timers" who developed mines where engineers would fear to risk a failure. The idea also became popular in technical circles that a mine must have ore blocked out, which the engineer could measure and estimate, thus avoiding all risk for his employer. Someone else must take the initial chance. As a result, mining exploration in the West dropped into the comparative stagnation in which it still struggles, because capital is hard to raise for new enterprises. In spite of his lack of vision in this respect, the technically trained engineer has done a great deal to advance the industry. If he has assumed something of the old practical miner's contempt for expert opinion other than his own, it must be regarded as a necessary evil, attendant upon success. The great requirement in mining, inherited from pioneer days, is to get tangible results, and mining geology is at present handicapped in that particular.

GEOLOGIC WORK in mining districts was undertaken at a comparatively early date by the federal government, and many of the states followed this lead. The character of much of such work is excellent, and many economic geologists have received their training on the various surveys. If any criticism were to be offered of this branch of economic geology it would be that it tends to follow rather than lead development, and that too often there is such a lapse of time between the field work and the publication of results that much of the information is out of date, or otherwise useless, except as a record.

Many geologists have made national reputations on the Survey and have then gone into private practice as consulting specialists. These men have excellent scientific training, but are weak in strictly mining experience. The areas which they survey are much larger in government work, and less attention can be paid to underground details than is possible in private practice. On the other hand, the resources of the government laboratories, and the assistance of various specialists, permit the solution of many problems of general interest. Because of the prestige given by high rank in the U. S. Geological Survey, men with such standing have been offered great opportunities in mining geology by the larger operating companies. At one time, in comparatively recent years, mining geology had a great vogue in this country, and much was expected of it. In fact, more was expected of it than could possibly be accomplished, and the result was disappointment and rapidly growing skepticism on the part of mine owners and operators. Beautifully elaborate reports, modeled upon those of the Geological Survey, were made as a result of extended

and costly examinations; in some respects these were too well done. Frequently the language was so highly technical that it was unintelligible to the mine owner without a scientific education. Recommendations for new work would not stand the criticism of the operating men, who were inclined to be critical, if not a trifle jealous, of the expert. As the field work was costly, compared to other surveys, and touched the mining problem only at a given point in time, the advantage of continued familiarity with underground conditions was sacrificed.

TO CONCLUDE that the comparative failure of mining geology to make a satisfactory place for itself in the industry was due entirely to lack of adaptability to existing needs on the part of the older geologists would be a mistake. Something of the failure must be attributed to the attitude of the mine owners and executive heads, who would not help to fit the new science to their needs. In the introduction of any new process or device, many changes must usually be made before it becomes satisfactory from a practical standpoint, and this is true in the subject under present consideration.

Officers of a mining company formerly would employ a geologist of standing whose previous experience had been either on a state or federal survey or, possibly, that of a teacher at a university. Naturally, a man of exclusively scientific training would be likely to write a report which the mine manager could subject to destructive criticism; the recommendations might be impractical in some respects; or the manager might not be able to see the application of scientific facts to his operating problems. It is extremely difficult for a man to go into a strange mine, and in the short space of a few days or weeks, gain the same detailed knowledge that is possessed by intelligent and observant members of the mine operating staff who have been on the job for years. In this connection it may be noted that, although the men in charge of a mine may have a great deal of valuable knowledge regarding ore occurrence and other geologic facts, they rarely make systematic records of their observations and conclusions, and often fail properly to correlate and interpret their information, so as to make the most use of it in directing future operations. These shortcomings are not of serious importance, however. Control of development work always rests with the mine manager; and, if he is willing to co-operate with the geologist, he can usually work out a proper program which will meet his needs. The geologist's work, to be of most value, should be carried on regularly during the life of the mine, so that he may have an equal opportunity with other members of the staff to keep in touch with underground conditions. It is commonly argued that this is too costly, and an unjustifiable expense, although it can be shown that the cost amounts to only a few cents per foot of drift or crosscut.

ANOTHER FACTOR that has tended to discredit mining geology is that most college graduates in geology know very little about practical methods in their chosen field, and yet they have been called upon in many instances to carry on geological work as an adjunct to mine surveying and other engineering, with little or no instruction in mining geology from the practical standpoint. Unquestionably a great deal more could be done in the average college course to turn out men with a more practical training. Engineering schools should not try to go too far in this respect, but should either train their students in certain rudiments of practical work or require that the necessary experience be gained as a prerequisite to a technical degree. I have found that inexperienced college graduate engineers are usually at a loss when it comes to distinguishing the altered rocks commonly found in the vicinity of ore deposits. Often they are much confused by the appearance—so different from what they have been taught to recognize in the laboratory—of rocks or minerals underground by artificial light.

Methods of detailed observation and records of such work are also little understood by the technical graduate. In most fields of engineering it is essential that the newcomer serve a long period of apprenticeship before being entrusted with work of importance. This has usually not been the rule with young geologists. The practical miner, or mine superintendent, naturally has a poor opinion of a technician who knows little of the practical side of mining; and, on the other hand, the operating man is usually so little versed in geologic knowledge that he cannot recognize the difficulties with which the geologist has to contend.

At first, mining executives hoped for great things from the geologist. They expected him to solve fault problems infallibly and to find ore without fail, frequently where no ore was to be found. They quickly became disillusioned, and swung to the other extreme, holding the view that the geologist's opinion is no better than the guess of any man who comes along claiming to be an expert.

THERE is no way of proving that the geological study of a mine will produce results except by carrying it out and then doing the work necessary to check up on the geologist's views. This brings up one of the great difficulties that applied geology must meet. In the early days of development of a good mine there is likely to be plenty of ore, and the necessity of close study of underground conditions is not realized; the company executive does not scrutinize very closely the new work which is being done on the initiative of a mine foreman, or mine superintendent, because the mine is making money. At a later period in the history of the property conditions are different; little or no ore is in sight, and possibly many thousands of dollars have been spent by the management fruitlessly looking for ore. As a last resort the geologist is called in, perhaps because no one on the job cares to shut down. It may be found that there are several good chances, but some of the levels have been abandoned and are caved; no reserve funds are left to carry out the new work. It may even be that the man in charge of the property does not want advice as to new work, but wants his own ideas supported. Frequently the management, after exhausting all available resources, wants a favorable report to serve as a basis on which to raise more money. In any event, entirely too much geologic work is of a "post-mortem" character, and it does not have even a reasonable chance of success.

Then there is the fact that it is often impossible to obtain recognition of some perfectly obvious condition upon which a geologist can decide with the practical certainty of being correct in his opinion. I can cite several instances where the simplest of geologic facts have been disregarded in operation. Such an example was that of a mine that attracted attention in the West a few years ago, where valuable orebodies near the surface were caused by secondary enrichment; all available evidence indicated that the primary sulphides were

too low-grade to make ore, and yet thousands of dollars was spent trying to find ore at depth, without fully prospecting the upper productive zone. Another instance was that of an outcrop of a supposed copper vein which showed no trace of original sulphide mineralization and no indication of copper. It was supposed to be completely leached, and a prospect shaft was sunk five hundred feet, with several levels run for exploration, in spite of a plain statement by the geologist that the vein was probably barren and that other parts of the property were much more promising.

From the foregoing it might be a fair conclusion that the place for a mining geologist is in the laboratory, because his chances in the field are so poor; but, as a matter of fact, a new type of engineer is being developed by the necessities of the industry, and it is to this engineer that the term "mining geologist" should be given, rather than to the theoretically trained geologist who undertakes mining work; possibly it would be better to call him a geologic engineer, to distinguish him from his predecessor. It may be interesting to consider the possible place of the geologic engineer and the training he should be given.

ONE of the first requisites of his equipment is that he shall be naturally gifted with the faculty of close observation; this is not nearly so common a gift as might be supposed. Next, he must have sound training in geologic theory and practice, with which must be combined a reasonable amount of practical mining experience, such as can be gained only by doing enough underground work to appreciate the operator's point of view. The most fascinating field for the geologic engineer will always be prospecting, even though electromagnetic or other new methods may take away some of the element of chance. There is nothing so interesting, in my opinion, as to watch the opening of a good prospect, with new faces exposed daily, samples to be "panned" or assayed, and the thrill of discovery in the air. Anyone who has ever been in a new camp during the period of excitement will always remember the experience. And as for the man who goes into a new country, makes an original discovery, and starts a "stampede," the chances are that he will spend most of the rest of his life trying to repeat the feat.

In prospecting work the geologically trained engineer should be able to render distinct service. It is true that our knowledge of outcrop indications is still woefully deficient on important points. Many solemn geologic monographs and textbooks may be read without learning of the surface characteristics of veins. Leasers and "pocket hunters" in many localities have a very much better working knowledge of outcrops than most geologists, and it is often amazing to see the careful observation and attention to detail employed by such workers. Gradually, however, the facts are being studied from the scientific standpoint, classified, and recorded, so as to be of use in further prospecting. This is especially true of the outcrops of certain copper deposits, and some work has also been done on leached cappings of gold and silver veins. There is still a wide and interesting field for further research and investigation.

In mine development the geologist's services may be of great assistance in determining at an early stage the main facts bearing upon ore occurrence. The time to get this information is during the period that the initial work is being done, because it is always expensive to go back to a drift or stope, or reopen an abandoned level, to check up a possibility.

The matter of keeping a proper record of conditions encountered is very important. It is, unfortunately, a common experience to find that many thousands of dollars have been spent on workings which have become inaccessible, without keeping specimens of vein material or wall rock, without recording the location and dip of faults, and even without taking any samples, or properly locating those which were taken. The mine foreman will tell you that no ore was found, or that he was told that such was the fact by someone else when he came to the property. Sometimes it is the other way round, and a greatly magnified story becomes current as to a discovery made in an abandoned winze or shaft; and large expense may be incurred in work which proves the report to be untrue. Well-kept records will always prove their worth sooner or later to the management of any company sufficiently competent to have them made and to keep them available.

In planning operations in the broadest way, a geologic engineer should render valuable service. For instance, the decision on a certain method of mining may be affected by the location and character of faults, which may often be determined in advance of operations by doing a little digging in the right places. A vein wall which appears entirely satisfactory to ordinary inspection may be regarded quite differently after closer study as to its manner of breaking and its composition. Sometimes a few drilled holes or short crosscut will reveal unfavorable conditions.

It is better to spend money in the manner indicated than to find out too late that a given method of stoping will not prove suitable, because the walls will not stand over large openings, or because they tend to break down upon exposure to air or moisture. I recall one mining operation that failed because a shrinkage stope system had been used as the most promising method of mining in figuring probable cost, and in practice it could not be followed because a clay seam came away in slabs from the hanging wall as the stopes were drawn, and lowered the grade of the ore to such an extent that it could not be handled profitably. Such points are properly matters for the geologist to investigate. A large amount of study, in the field and in the laboratory, can be justified when its cost is compared to the simplest step in actual mining.

ANOTHER QUESTION that often arises is whether or not ore as sampled in place in the vein will yield a corresponding grade upon mining. The points concerning walls have just been mentioned. It is often possible to gain a great deal of information as to probable uniformity of the vein by careful study. One can also determine if sorting in the stopes will be practicable, and whether or not it will be necessary to make considerable reduction of the apparent tonnage and value to compensate for possible inaccuracies that may occur in the process of sampling.

Some may consider these matters to be of interest to the operating engineer rather than to the geologist, and that sampling, at least, is something definite, something that may be carried out according to fixed rules. But it often happens that a simple fact regarding ore occurrence will entirely upset a mechanically accurate piece of sampling work. Certainly, sampling that does not take into account the details of ore formation is less likely to be accurate than that which does, and the geologically

trained engineer will turn out a more intelligent piece of work in this respect than one who is only a good hammer man.

The great need in the application of geology to mining today is to reach those operations that are not of sufficient size to require the employment of a geologist all the time. In fact, it seems probable that even with respect to larger companies, more efficient service could be given than is commonly obtained at present. By "efficient service" I mean capable technical work at the lowest cost. Some operators are getting excellent work, but at a comparatively high cost, because there is not enough work to occupy the full time of a high-salaried man to best advantage.

Under present conditions most consulting geologists who do mining work are obliged to charge a fairly high fee because they are idle so much of the time, in common with consulting engineers. This is not a desirable condition because it makes the work more expensive to the operator than it should be, and prevents the geologist from spending the time in the field he ought to give to such work, in order to widen his experience and practical grasp of his subject.

In my opinion, geologic engineering should be conducted on a contract basis, much as diamond drilling is done in many mines. The rate of pay should be such that with from three to five mines of average size to cover, the engineer would make an income comparable to that of technically trained men in other fields. The work should continue from year to year, so that the geologist could keep in close touch with mine conditions and be prepared to advise on questions as they arise. Records would be kept up to date, and would become increasingly valuable, not only from the mine operator's standpoint but also from the scientific aspect. When mine operators are inclined to place their engineering, with respect to geology, upon such a basis they will have no fault to find with the results obtained.

Prospect Drilling in Southeast Missouri

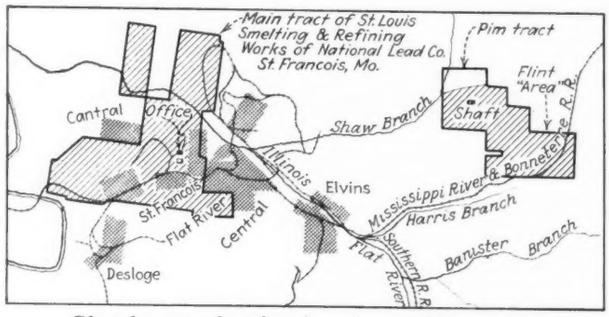
By Roy H. Poston

St. Louis Smelting & Refining Works of National Lead Company, St. François, Missouri

THE No. 7 mine of the St. Louis Smelting & Refining Works of the National Lead Company is situated on what was formerly the Pim Tract, located in Secs. 20, 29, and 30, Township 36, North, Range 5, East, of St. François County, Mo., and is the southernmost operating mine in the Flat River district at this writing. A part of this tract was optioned and drilled by a mining company in 1907, but was rejected after a short drilling campaign. The St. Louis Smelting & Refining Works secured an option in 1915, and the entire tract, containing 680 acres, was purchased by that concern in 1917, after an extensive diamond-drilling campaign had been completed. An article that appeared in the Jan. 6, 1917, issue of *Engineering and Mining Journal* concerning this tract is interesting. It reads in part: "The famous 600-acre Pim Tract in the high flint hills south of Flat River, that was supposed to be beyond the Flat River basin, was taken over at $275 an acre after the development of a large orebody at 500 to 800 ft. This tract went begging in the early days at $10 an acre, and was regarded as absolutely hopeless by the old-timers, as it is covered by the 'Potosi' formation, under which even a former state geologist thought there was no hope of finding disseminated lead. When a Boston promoter acquired this property about fifteen years ago, and attempted to float a large corporation, he was scoffed at and derided by the other operators . . . but his 'rank heresy' is now found to have been one of the largest orebodies that has been discovered for many years."

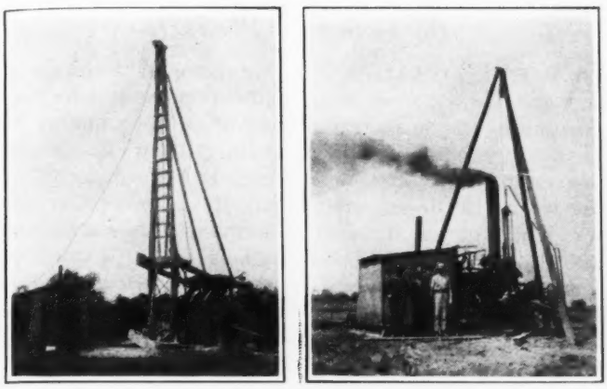
Diamond drilling was continued intermittently after the purchase until July, 1922, when a shaft was begun on the property; this was completed in February, 1923, at a depth of 755 ft. Incidentally, this shaft is the deepest in the district, although, strangely enough, not the wettest. The mine has been operated continuously since its opening as a result of new orebodies being constantly blocked out with the diamond drill.

The Potosi formation contains, among other things, flint, or druse quartz, in large and small crystals bedded in the country rock, (see table). This formation has undoubtedly prevented the discovery of this orebody for many years and still presents a formidable barrier to prospecting with the diamond drill.



Sketch map showing location of Pim Tract

Since quartz has a relative hardness of 7 as compared to 10 of the diamond, it can be understood readily that when the two substances come in contact under pressure, as in diamond drilling, they will both undergo loss of form and substance—a very expensive loss in the case of the drill carbon, or black diamonds. After considerable experimentation, involving close setting of diamonds and the use of stones of various sizes, to prevent diamond breakage, it was found that the use of a churn drill to put down the sleeve hole to a point through, and below, the flint formation was more economical in the end than trying to diamond drill through it. Since an occasional flint nodule is found in the light gray limestone just below the main body of the white limestone and flint formation, the churn-drill holes are extended in all cases to the top of the Davis shale, below which point no trace



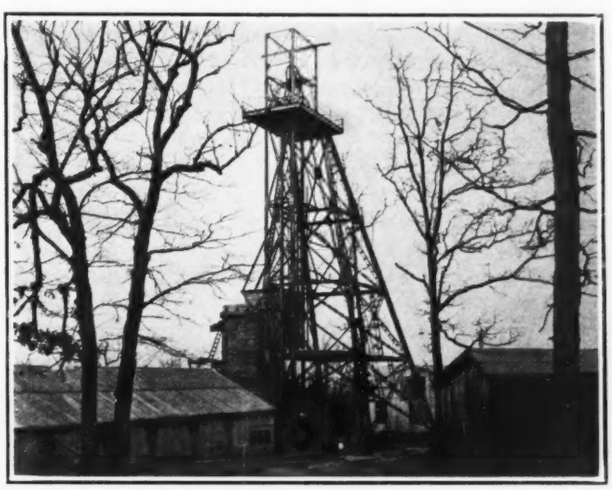
Churn-drill and diamond-drill rigs on the Pim tract

of flint has as yet been found. The churn-drill holes are 6 in. in diameter, and are from 75 to 250 ft. in depth, the variation being caused by the gradual dip of the shale formation to the southward. A hole of this diameter is advantageous for two reasons. First, the string of tools of this size carries sufficient weight to insure the cutting of a straight hole, and, second, it makes easy the setting of the 3-in. pipe casing for the subsequent diamond-drill hole.

Churn-Drill Operations

The churn drills are operated continuously throughout the 24 hours of each day, six days each week, necessary repairs and adjustments being made on Sundays. Two Keystone gasoline-operated churn drills (a No. 2½ and a No. 5½) are in service in this area. Both machines are of the traction type, and, although the country is rugged, little trouble is experienced in moving them from one location to another. Owing to the fact that no watchman is employed to look after the machines over Sundays, some trouble was experienced from petty thievery of gasoline remaining in the tanks after the end of the Saturday-night shift. The use of a mixture of half gasoline and half coal oil for operation of the drills has proven to be a very effective "lock."

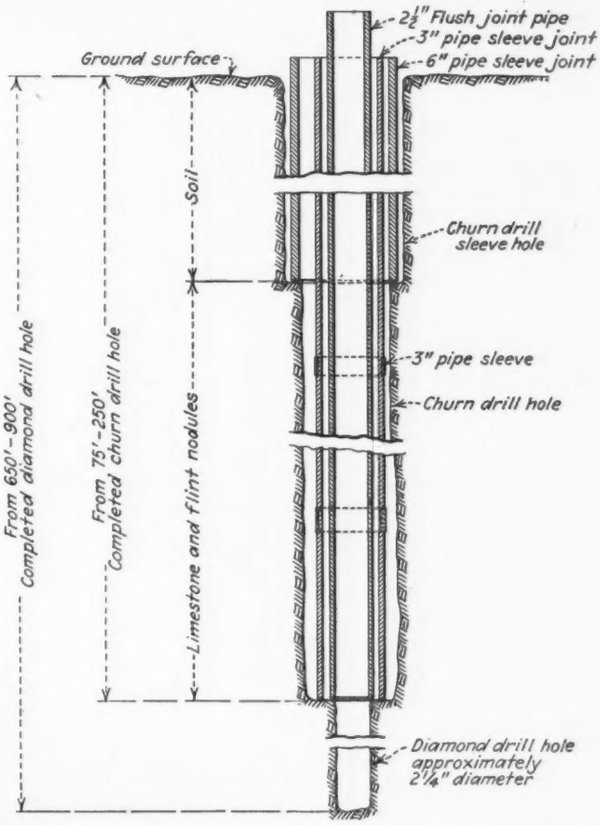
The country rock, where no flint is present, cuts rapidly, but the presence of "flint beds," as the drillers term



No. 7 shaft of the St. Louis Smelting & Refining Works of National Lead Company

the irregular flint deposits, cuts the drilling speed in some cases as much as 50 per cent, owing in part to the fact that the flint wears the "gage" off the cutting bit of the churn-drill tools; and this requires frequent changing of bits to maintain the required size of hole. In this work, each churn drill has three rock bits as regular equipment, so that two of them may be going through the process of being sharpened while the third one is drilling. The drill crews, consisting of one operator and a helper, sharpen their own bits while the drill is in operation, only a bad break, or some unusual incident, necessitating a trip to the plant blacksmith shop. Ordinary run-of-mine coal is used for heating the bits; they are tempered in clear water, no oil or salts being used in this process.

The accompanying sketch shows graphically the procedure necessary for the preparation of a churn-drill sleeve hole, which is to be completed later by use of a diamond drill. The churn drill, using, first, an 8-in. bit, cuts a hole through the top soil, boulders, and decomposed rock,



Typical sleeve hole showing necessary pipe casing

down to solid caprock. This hole is "cased" by the insertion of a piece of 6-in. pipe, using standard outside sleeve joints, to prevent the caving of dirt and rock. Drilling is then continued with the 6-in. rock bit, through the 6-in. pipe casing down to the top of the Davis shale. All mud, rock, and cuttings are then pumped out of the hole, as completely as possible, and a sack of portland cement is slowly poured into the hole. Since the ground water "stands" at about 90 ft. below the surface of the ground at all times, there is sufficient water in the hole to provide the necessary moisture for the cement. After the placing of the cement, 3-in. standard pipe is inserted in the completed churn-drill hole to its full depth; the bottom section of pipe rests in the cement and thereby forms a bond with the rock bottom of the hole. The 6-in. pipe sleeve at the surface is removed for use elsewhere, and the churn drill moved to its next location.

When the diamond drill is moved to the hole, which is now known as a "sleeve hole," 2½-in. standard pipe, with flush point couplings, is placed inside the 3-in. pipe. This 2½-in. pipe extends the full length of the hole and is necessary to prevent excessive vibration of the diamond-drill rods during drilling. Such vibration would occur as a result of the difference between the diameter of the rods—about 1⅞ in. in outside diameter—and that of the outer pipe sleeve, which is 3 in. in inside diameter. If it could be determined in advance of the diamond drilling that it would be unnecessary to enlarge the subsequent drill hole by reaming, in order to recover a stuck bit, it would be possible to dispense with the outside casing and use only the 2½-in. inside casing. The standard bit reamer is too large, however, to pass through this 2½-in. casing, which must be removed before reaming is started.

It has been the experience of the National Lead Company that the portion of the hole put down by the churn drill, as explained above, is slightly cheaper in cost per foot than that portion of the hole completed by the diamond drill.

Typical Cross-Section of Diamond Drill Hole

Depth, Feet	Geological Formation	Nature of Rock
0 to 27	Recent	Soil
27 to 65	Potosi limestone	White limestone and flint
65 to 114	Potosi limestone	Light gray limestone
114 to 145	Potosi limestone	White limestone and flint
145 to 177	Derby-Doe Run limestone	Light gray limestone
177 to 384	Davis shale	Shale
384 to 551	Bonneterre limestone	Light gray limestone
616 to 627	Bonneterre limestone	Gray limestone
627 to 647	Bonneterre limestone	Gray limestone
647 to 682	Bonneterre limestone	Ore horizon
682 to 731	Bonneterre limestone	Light gray limestone
731 to 741	Bonneterre limestone and Lamotte sandstone	Sandstone and limestone
741 to 754	Lamotte sandstone	Sandstone

Alaskan Expedition of U. S. Geological Survey Returns

The Interior Department announces the completion of the field work of another exploratory expedition in Alaska by the Geological Survey and the bringing back of maps and information regarding a tract of more than 2,000 square miles in the Alaska Range and adjacent country on the west side of Cook Inlet, in the environs of Mount Spurr, that has hitherto been shown as a blank area on all authoritative maps. This exploration is one of the series that the Geological Survey has been making throughout the last 30 years. The party consisted of S. R. Capps, geologist in charge; R. H. Sargent, topographic engineer, and four camp men. Transportation in the field of the necessary provisions, supplies, and equipment for 100 days was furnished by a pack train of fifteen horses. From the time when the party landed at Trading Bay, on the west side of Cook Inlet, about the middle of June, until it returned to that place at the end of the field season, about the middle of September, the members were entirely out of communication with the rest of the world and saw no human beings other than one another. The results of the expedition are now being compiled for publication. Among the many items reported are the discovery and mapping of a large river, numerous lakes, glaciers, and mountains, and an active volcano. The newly discovered large river is the Chakachatna, whose drainage basin covers an area of more than 1,100 square miles. This stream is a roaring torrent far too swift and too deep to be forded even with horses; in fact, measurements of its current at several places were impossible.

Organized Knowledge Finds Markets for Industrial Products

AN EDITORIAL in a recent issue of *Engineering and Mining Journal* drew attention to the latent opportunities for an increased use of iodine—a mining industry byproduct. The following, from an address delivered by Dr. Max Mason, president of Chicago University, at the recent convention of business-paper editors in that city, is strikingly illustrative of how a broader knowledge will insure new markets for a product, although the research which led to that knowledge had no such immediate object in view. Dr. Mason reminded his hearers that the thyroid gland regulates bodily processes and mental processes, metabolic rates, rates of chemical combination and rates of productivity in the body. Some years ago, he relates, an American took a large number of thyroid glands of sheep and isolated from these the exact chemical responsible for the gland's activity. Previously, macerated sheep thyroid had been given to patients to help them when the thyroid balance was disturbed. And of course today, in medicine, that is one goal of research—the determination of the exact composition and quantity of chemicals, the hormones, which, released from the ductless glands, regulate the physiological processes of the body. This substance was then isolated and called thyroxin—a definite organic compound. It could be used in dosage. It was pure.

The work was repeated by an Englishman in England, using the glands from sheep in England. He obtained, per pound of sheep thyroid, much larger quantities of thyroxin than the American had found. The American was interested to see if the Englishman's process was better, so he repeated the experiment, using the Englishman's process exactly, but again on American sheep thyroid. The results were as before: He recovered only minute quantities of thyroxin from the thyroid glands of the Montana sheep with which he was working. He sent to England for thyroid glands of sheep and found that some of them had large quantities of thyroxin, others small amounts. He discovered that the sheep that possessed large quantities of thyroxin in the thyroid gland were heavy wool growers; the others were scrawny and no good for wool. The answer then was immediate.

Physiologists have known for years how to stimulate the thyroid gland. Iodine has been given as a preventative of goiter. So the result of this medical research was that the sheep in Montana were fed iodine. Increased activity of the thyroid gland resulted and they became valuable wool growers.

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By the Way

"FOLLOWERS of the mining industry in the Northwest," says Koch's *Mining Review,* published in Spokane, "will recall that stock in the Bunker Hill & Sullivan Mining Company sold for $75 a share during the early summer months of this year. In the fore part of October the stock soared to $150, an advance of 100 per cent in a few months, and another positive proof that Mining Pays in the Northwest"—in capital letters just like that. The opinion may be ventured, however, that this particular incident is not so much proof that mining pays in the Northwest as that the company's holdings in Ontario are expected to pay.

DISCUSSION

A Pendulous Doodle Bug

THE EDITOR:

Sir—Our profession is generally presumed to be based upon concrete facts and scientific principles. Nevertheless, during the course of our work mysterious and intriguing events are often encountered. As a geologist I, of course, look upon divining rods, hazel sticks, and doodle bugs as the most absurd incongruities in relation to this science.

The divining rod had its origin in medieval times, when science consisted mostly of mysticism. As science developed and its understanding became more prevalent, the divining rods and other instruments for locating mineral deposits continued to interest people, and even today one often hears of very interesting experiences with devices such as these. For a bit of light reading for your subscribers I wish to tell you of an experience which I had this summer.

A certain contract oil and gas well driller in western Pennsylvania had been having miserable luck in bringing in good wells. He left the state and went to Texas for a short time. While there he became acquainted with a man who claimed to be a German scientist and the inventor of a device which would accurately locate reservoirs of oil and gas. This driller paid several hundred dollars for the device. He returned to Pennsylvania and immediately began drilling wells upon locations indicated by the doodle bug as being in oil- and gas-producing territory. His success has been little short of phenomenal since he has the aid of this mysterious device.

He wanted me to see the doodle bug in action, and it so happened that the only time I could see him was late one night last August. We took the doodle bug to a cornfield under which is a large natural-gas pipe line.

The doodle bug is conical, flat on the bottom and covered with rawhide. It weighs between three and four ounces and contains a liquid. A shoestring is tied to the peak. The operator sits down upon the ground and holds the doodle bug by the string between the thumb and forefinger, close to its junction with the instrument. If the indications for oil or gas are there, the doodle bug immediately begins to swing with an elliptical motion. The quantity of oil or gas lying beneath the spot is supposed to be in a direct proportion to the violence with which the doodle bug swings.

The driller sat down upon the ground over a gas main. The doodle bug immediately began to swing rapidly. When the doodle bug was taken away from the gas main its action gradually died away, and at a distance of 200 yards it did not respond at all. I sat down at the same location over the gas main, and the doodle bug refused to work. My assistant then sat down and held the doodle bug. It immediately became much excited. I then went farther down into the field, where the main was uncovered, sat down on it, and held the doodle bug within three inches of the pipe. Immediately, and much to my surprise the doodle bug became very enthusiastic. Tests were made at various points along the line, and results were equally good for all three of us.

It is indeed a novel experience to spend an hour working a doodle bug by the glow of a flashlight late at night.

The driller wanted me to go with him next day to a location he had made preparatory for drilling for gas and check the doodle bug with my geological data. I could not go, but my assistant visited the location. He found that it was located on the flank of an anticline and geologically was possibly the best location that could be had in the territory. He reported to me that the doodle bug was very much pleased with the location, and as it was taken away from this particular spot it evinced its displeasure. Further up the structure and down the structure it refused to work.

There must be some psychological explanation to the action of this mechanism. Mine is as follows: In the subconscious mind of the operator there is a desire for the doodle bug to move. The operator has a hunch that this spot is better than any other. In his desire for this hunch to be a true one there is a sympathetic nervous reaction which results in a minute contraction of the muscles in the arm and in the thumb and finger which holds the doodle bug. This contraction is possibly modified and given a motion by increased heart action caused by expectancy. The result may be that a minute involuntary rotary motion of the thumb and finger tip is set up to which motion the doodle bug, which is exquisitely balanced, responds. In other words, through involuntary thought and motion the doodle bug responds best at the locality where the operator thinks it should show the best reaction.

J. D. SISLER.

Harrisburg, Pa.

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Revising the Mining Laws

THE EDITOR:

Sir—Under the above title, in your issue of Nov. 19, a correspondent suggests a new provision allowing the location of tracts in extent up to 160 acres—conforming to land surveys where such exist—for all types of mineral deposits, but without apex or extra lateral rights, substantially as now in effect for placers.

It is suggested that the annual labor or expenditure be reduced from $5 per acre to $2, and that proof of labor, together with the original location notice, be filed with the registrar of the Land Office as well as with the county recorder.

The above provisions, I believe, are good ones, and should arouse no such opposition as have all other suggested changes in our present antiquated mining code; especially if, as your correspondent proposes, the present method of making locations be allowed to remain in effect, for those who may prefer to operate under it.

The last proposition, however—that no location be recognized unless or until evidence of valuable mineral in place be exposed—I believe is most unreasonable and unjust, and to always have been so. Is the discovery and development of mines so inimical to the public welfare that it should be discriminated against and discouraged? The location of a homestead, desert entry, or grazing homestead—and I know not how many other varieties—all of which can be made on unoccupied public lands, even though mines are operated in the vicinity, is encouraged in every manner. A small fee only is required to file, a residence for but a part of the time is required, no annual labor or expenditure is exacted on some forms of filing, and the final title or patent is given at only a fraction of the sum required of the miner.

In any contest between a miner and a homesteader or other entryman within my observation the miner has lost out. A flagrant example occurred in the Bisbee district some years ago. A group of mining men had located some claims, the surface of which was covered with several hundred feet of detritus. From the geology, as demonstrated by the workings in adjoining mines, payable bodies of ore could not but exist at a known depth, and these locators had been sinking a shaft, gaining depth each year as their means allowed. Some sort of a desert or other filing was made by others over the ground, and in a court contest the miners lost on the dictum that no legal mining location was possible without previously demonstrated mineral in place.

Whatever changes are made in the procedure of locating mining ground—be it with or without extra lateral rights, conforming or not with public land surveys where such exist—let the requirements for entry, the fees and expenditures required for continued occupancy, and the final steps and expense in securing title or patent be fully as liberal to the miner as is now or ever shall be extended to the usually sincere homesteader or cattleman, the hopeful smoke farmer, or the ubiquitous bootlegger. The miner should no more be required to demonstrate the possible exploitation of his filing for his objective than is the farmer or cattleman for his.

Tucson, Ariz. A. L. PELLEGRIN.

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Examining Engineers and Mine Vendors

THE EDITOR:

Sir—In connection with Philly Delphia's excellent report on "Gold Mining in the Sauerkraut Belt," may I be permitted to submit the following to the Committee on Standardization of Mining Methods, as a ritual to be used in all dialogues between examining engineers and would-be vendors:

Q.—And is your property by far the most promising that you have seen in all your 20 (40) years of mining experience?

A.—It is, and it lies in the heart of a richly mineralized district.

Q.—Then only lack of capital has prevented its development into the largest camp on the American (Eurasian, African, Australian) continent?

A.—Even so, and whoever has the courage to undertake development is certain to reap a rich reward.

Q.—And are your geological conditions identical with those of the Hollinger (Kennecott, Butte, Rand, Pachuca, Braden, Broken Hill) mines?

A.—Yes, and the orebody is becoming not only wider but richer with depth.

Q. —Does tradition state that the workmen took out high grade ore until the rising water, reaching their chins, forced them to abandon the workings?

A.—Yes, and there are still thousands (millions) of tons of ore in the winzes which are unfortunately filled with water.

Q.—Can you show me an assay certificate indicating that a sample carried $100 ($1,000) per ton?

A.—That sample was a selected specimen, but the ore is the same throughout a width of 20 (100, 1,000) feet.

Q.—I presume that those drifts which are barren are off the main vein?

A.—They are, and the crosscut tunnel is not under the principal oreshoot.

Q.—Were not the former unsuccessful operations on too small (large) a scale?

A.—Manifestly, and furthermore the proper method of ore treatment has never been applied. H.E.M.

* * * *

Practical Transmutation

THE EDITOR:

Sir—I have been reading up my metallurgy, and incidentally I have been near to tears with those (office) metallurgists who are wailing over the mounting price of tin and wondering what substitute we can possibly find to take its place before it gets clear out of sight. Here is the result of my profound meditations:

Among the many recent revolutionary changes in our point of view I have failed to find any other so striking as that of our modern conception of the atom. For many years, following the ideas of the good old Quaker, John Dalton, we viewed the atom as the smallest constituent of matter; now we know that the atom is itself of grained structure and, like the flea:

> "Great fleas have little fleas
> Upon their backs to bite 'em,
> And little fleas have lesser fleas,
> And so *ad infinitum.*"

We first discovered that radium, the new element of Madame Curie, spontaneously decomposes, passing through a number of intermediate forms and losing an atom of helium on the way occasionally, as well as much energy, and finally bringing up with that utterly prosaic and ignoble metal, lead. Then we discovered through William Crookes that uranium is also slowly decomposing, and that it, also, presently passes through the same cycles and brings up as the same old lead. From either radium or uranium the change is a change of degradation; at each change a loss of atomic weight takes place, the atomic weight becoming less, accompanied by a loss of energy.

It is hardly conceivable that the time will not soon come when our industrious—nay, indefatigable—chemists will have solved what remains of mystery in these transformations and will be able to chase any element up or down the ladder as they choose.

Think what a proud position the lordly possessor of a productive lead mine will then occupy, and the office metallurgists will then need no longer worry about the price or supply of tin. If I find, on consulting my bank account, that it will stand the strain, I shall immediately go out and buy at least a ton of lead.

When that happy day dawns it will be at once possible to convert my ton of lead (worth now probably about $160) into at least half as much platinum (worth at

the least calculation $800,000), thus making me rich at a single stroke. On reflection, I think I had better buy two tons. Of course, if others also convert lead into platinum, the latter metal will decline in price; but we can hardly have too much platinum; for think what wonderful stoves, water pipes, coal hods, spittoons and even cups and saucers it will make! These things will surely soon come about and the millennium will be close at hand. EDWARD HART.

Lafayette College,
Easton, Pa.

* * * *

A Question of Linguistics

THE EDITOR:

Sir—For months now I have been waiting for an issue of *E. & M. J.* in which the question would be asked—but as it has not appeared I am going to ask—Why, according to the article in the issue of reporting the meeting of the geologists, was the King of Spain upon entering the hall cheered in the Italian tongue; or was it Catalan?

Then that interview with the Queen, wherein she explains just how Los Angeles should be pronounced, recalls the now ancient story of the lone American who was touring England. One day he stripped a gear out on a country road and, while waiting for the garage man to arrive from the neighboring village, repaired to a near-by house where he was invited to lunch. "Will you 'ave some 'am?" asked the father. Seeing that the American was somewhat puzzled, the son explained, "Father wants to know if you would like some 'am." Then the dear old mother made it perfectly clear by saying: "Both on 'em thinks as 'ow they are saying 'am." Now that pronunciation, as vouched for by the Queen, does not seem to be Catalan, nor Gallego, nor yet Vascongado: Is it possible that the Queen's tongue is Anda-loose?

Here is one that perhaps has not yet reached the States: In the fall of 1918 is was reported in La Paz that: "Los Alemanes piden la Paz," whereupon a patriotic old Paceña remarked: "No, no, ni Viacha los daremos." C. CARLETON SEMPLE.

La Paz, Bolivia.

* * * *

On "Calling" a Metallurgical Bluff

THE EDITOR:

Sir—I notice with interest your comments on "The Fiction of Unassayable Colloidal Gold," in the issue of Dec. 10.

In traveling over the country I have been approached several times by well meaning enthusiasts in regard to processes which they have developed for the extraction of more gold from the ore than can be assayed. If such a condition is true, I recommend that the methods of assaying be changed to incorporate in the laboratory a laboratory size unit of the process, or processes, so highly spoken of.

I wonder why this has never occurred to the well meaning propounder of the theory of unassayable colloidal gold. We have missed opportunities(?) of becoming rich through several of these new processes, all of which, of course, involve very fine grinding; but so far we have refrained from taking advantage of any of these wonderful opportunities. HARLOW R. HARDINGE.

New York City.

Engineers' Club of San Francisco

THE EDITOR:

Sir—An illustrated booklet, commemorating the dedication of the new quarters of the Engineers' Club of San Francisco, is available for distribution. You will be interested, we believe, in the fact that facilities of this sort have been established here and that the club is free of debt and operating on a self-supporting basis.

In recent years this club has become a focal center for activities of engineering societies in the San Francisco Bay region. It is our plan to extend this service to the profession and particularly to effect still closer relations with national engineering societies. In this endeavor we will greatly appreciate such aid and co-operation as you can give. NATHAN A. BOWERS,

San Francisco. President.

[We are glad to give further publicity to this statement. The club is to be congratulated on the acquisition of new premises and the engineering profession should be grateful to Doctor Bowers and his colleagues for their initiative and enterprise.—EDITOR.]

* * * *

A Word for Oregon Assayers

THE EDITOR:

Sir—I desire to comment on your editorial in the Sept. 10 issue entitled "Duping Prospectors With False Assays," noting therein that Dean Newton of the Oregon School of Mines denounced certain assayers. In the statements reported to have been made at the meeting Dean Newton and one A. B. Carter denounced three or four assayers of southern Oregon without mentioning names, and clinched the matter by stating that one of the assayers had made returns of 17 per cent lead on a sample of ground glass and charcoal.

I took exception to the accusations of the gentlemen and sent to them demands that they make their charges specific or apologize, as I knew that one of the assayers out of the three or four in southern Oregon was honest. They have not acknowledged the receipt of my demands or taken any action. I further pointed out to them that flint glass contains as much as 37 per cent lead, and, furthermore, that much of the opaque or white glass contains tin.

You exposed the fake tin business of the vicinity of Grant's Pass editorially in one of your July issues. The man mentioned therein, George Young, I am reliably informed, is an ex-convict. I have never heard that the assayers made any assay returns of tin in that fiasco, but have been informed that the prospectors themselves were the ones who obtained the mystery metal, and kept the matter alive.

You wind up your editorial with the recommendation that the assayers be licensed. In that connection I desire to call your attention to the fact that the engineers licensing law in Pennsylvania has been declared unconstitutional by its Supreme Court, and that the same laws in the State of New York are uninforceable because they violate the federal and state constitutions. For confirmation of this I refer you to the editorial comments in the issues of *Mining & Metallurgy* of March, 1925, and March, 1927.

I think you would do a good and timely service to give that subject some attention and publicity.

Portland, Ore. WILLIAM H. HAMPTON.

Engineering and Intelligence

THE EDITOR:

Sir—With great interest I read your article of Nov. 6 on "What Is Engineering," and also Colonel P. E. Barbour's analysis, and I too believe, with all the others, that it is an important question and should have a correct solution and definition.

I can hardly agree with those claiming that an engineer is not a scientist, or that he should be differentiated from the "pure" scientist who only produces a theory. The engineer, by the application of mechanical means, makes science practical and applicable for its economic employment by man; because, in order economically to develop the theory evolved by the mere scientist, the engineer must scientifically understand every element of the theory, and, in addition, must be sufficiently intelligent to apply economically the proper mechanical means to perfect, demonstrate, and commercialize it. Therefore, the "true" engineer must be a *scientist plus,* but nevertheless a scientist.

The word "judicious"—very common in use, in reality a misnomer and found to be so in many courts—may be displaced by the word intelligent, because correct or incorrect decisions are made and *experiments* are good or bad in ratio to the intelligence employed. All thought eminates from the Universal Mind or Supreme Intelligence, and our ability to render decisions is therefore in exact ratio to our understanding.

I therefore contribute the following possible scientific definition of the word "Engineering":

Engineering is the science of intelligent application of mind to the solution of the mechanical problems of man.

Los Angeles. H. C. KIRKPATRICK.

* * * *

Doodle Bugs

THE EDITOR:

Sir—The latest in doodle bugs, demonstrating the authenticity of newspaper accounts of a scientific or technical nature, recently appeared in a Nebraska publication, as follows:

"Geologists have had their heyday, for Imperial (Neb.) has a man who can 'feel' the presence of oil, according to whether he does or does not develop stomache. This oil wizard, L. F. Heseman, was recently brought to Imperial by B. B. Brown, operator of an oil drilling outfit. Stories were told before his arrival of the ability to 'feel' the presence of oil. Tests were made and Heseman was taken to prospective oil sites.

" 'This pool will yield 200 barrels daily.' 'About 500 barrels here,' or sometimes simply, 'Dry,' came from his lips. This was the trend of the conversation of the wizard. Later, a checkup was made on the various sites. Heseman's estimates held good. In almost every instance his decree of 'sickness' indicated the same amount of oil as on previous visits, though he was being conveyed in a closed car and consequently had no possible idea as to where he was.

"Heseman says he developed his remarkable ability back in his childhood days on his father's farm in Pennsylvania when he found it impossible to visit a portion of the farm without becoming sick. When he returned to his boyhood home he found the pastures bespecked with oil derricks. He set out to place his stomach at the services of the oil interests."

Thus, it will soon be possible to locate every oil field in the United States(?) providing Heseman's stomach lasts. We wonder what would be the result if such a claim were made about mineral lands of any particular nature. He probably will have as much effect on the petroleum production of the world as the "forked stick," "gold leaf," and other "doodle bugs" that are frequently about to "revolutionize" the "gold industry" or the "copper industry," in the words of newspapers of good standing in the country.

I suggest that Heseman take some "pink pills for pale children" or some ipecac, as the demand for petroleum dwindled or increased, and thus he might be able to regulate the supply.

Plymouth, Ind. H. F. G.

* * * *

Flotation Nomenclature

THE EDITOR:

Sir—The following comment may be apropos to the discussion regarding flotation nomenclature. I used the phrase "differential flotation" in my book after considerable thought, principally for the following reason: In all flotation operations on sulphide ores there is a tendency for all of the sulphide minerals to float. But, even under ordinary collective-flotation conditions, one kind of sulphide floats more readily than do the others, and it is by accentuating the differing tendencies to float that differential flotation is effected. It is not actually selective flotation to the extent that one sulphide is selected and the other or the others are rejected; usually a slight increase in intensity of the flotation effect will bring about marked increase in flotation of the so-called "depressed" sulphides. In other words, as I said before, they are trying to float all the time, but by control of the flotation conditions there is sufficient difference in flotation effect to cause one sulphide to float with substantial completeness and the other to float to an economically negligible extent.

Work in my laboratory shows that the differences in floatability of the sulphides are brought about by differences in gangue-slime coatings on the sulphides. With a given lead-zinc-iron ore the addition, for instance, of sodium bicarbonate, sodium cyanide, and zinc sulphate will produce a rather heavy gangue-slime coating on sphalerite and pyrite, sufficient to prevent their ready adherence to air bubbles, while the galena surfaces are substantially free of coating. Under such conditions galena will float readily upon the addition of 0.1 lb. per ton of a chemical collecting agent such as xanthate and 0.05 to 0.1 of a frothing agent such as pine oil. But if upward of 0.5 lb. per ton of a collecting oil, such as creosote, and more pine oil are added, zinc and iron will come up in considerable quantities. When galena has been floated, the addition of copper sulphate causes the slime coating to leave the sphalerite, and it can then be floated away from the iron under relatively gentle flotation conditions, whereas the iron is found to be heavily coated with slime. However, with the iron in the heavily coated condition, the addition of 0.5 to 1 lb. of oil will bring much of it up.

It is, I think, apparent that this whole operation is differential rather than absolutely selective, and therefore that the phrase "differential flotation" is more properly descriptive of it than the term "selective flotation."

New York City. ARTHUR F. TAGGART.

USEFUL OPERATING IDEAS

Solenoid-Operated Air Doors

By W. H. Carrick
Bessemer, Michigan

THE doors first used at the Ironton mine at Bessemer, Mich., were operated by air, which was controlled by wires leading up to a handle set at a distance from the doors. Trouble was experienced from this means of control. The motor crews objected because it was difficult to operate the handles and occasionally the wires stretched so much that the valves did not open, with the result that the train occasionally smashed a door. No man door was provided alongside the train door, and the men were afraid of the latter. For these reasons it was decided to install electrical control.

In designing the new control consideration was given to the automatic operation of these doors by a switch located in the trolley line. The electricians objected to this because the switch, previously tried out on other work, tended to throw the trolley pole. It was decided finally to use a manually thrown switch.

When the electric control was first installed, if the switch handle were thrown too violently, the door would open and immediately reclose without further operation of the switch. A relay was placed in the system so that one operation of the control switch completed one operation of the door, either opening or closing it.

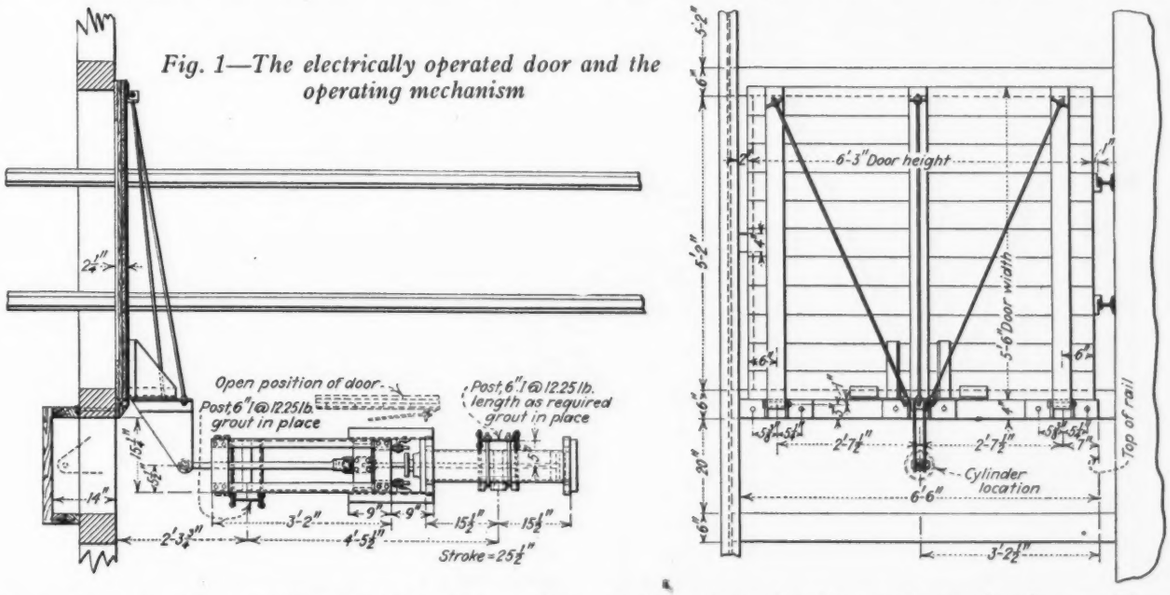


Fig. 1—The electrically operated door and the operating mechanism

As the electric equipment is now installed a specially constructed switch is placed on each side of the door at such distance from it that the door has ample time to open before the train reaches it. Armored cable connects the switch to the operating mechanism. Contained in a box at the door is relay *B* (Fig. 2) which insures a single complete operation of the door for one throw of the switch; a relay, *A;* also a two-pole knife switch for cutting the power off from the door, should any work have to be done upon it or should it be desired to keep it open. The jog switch is on the outside of the box; also a pilot light to indicate whether the power is on. The door is operated by a solenoid directly connected to a slide valve which has a counterweight on the bottom of the valve piston rod. When the solenoid is energized, the valve is raised and the door is closed. With no power in the circuit, the counterweight pulls the valve down and the door opens. Should the power go off, the hand-set relay *A* opens and the door opens at the same time, the relay remaining open until reset by the jog switch. When the jog switch is reset the door will immediately reclose, and not until then. This means that there is no danger of the door closing when a train is going through, should the power come back on. This control is operated from a 220-volt, a.c. lighting circuit.

The older types of doors were opened and closed by a bar connecting the center of the doors and the end of the piston rod. Our new level is equipped with a door of new design shown in Fig. 1. In this design the action is almost in a straight line with the cylinder, and the opening and closing is accomplished through lever action. In this two purposes have been accomplished: the length of the cylinder has been reduced, thereby requiring less air, and the door is not warped or bent by a force applied at its center. In the latest installation an orifice diaphragm, with a $\frac{3}{32}$-in. opening, has been inserted in a union in the $\frac{3}{4}$-in. pipe leading from the main air line to the air cylinder. Placed between this union and the cylinder is a small receiver made up of a piece of 4-in. pipe 6 in. long. A gage is attached to this receiver. In this way a reserve of air at 105-lb. pressure is maintained to start the closing or opening of the door, the air gradu-

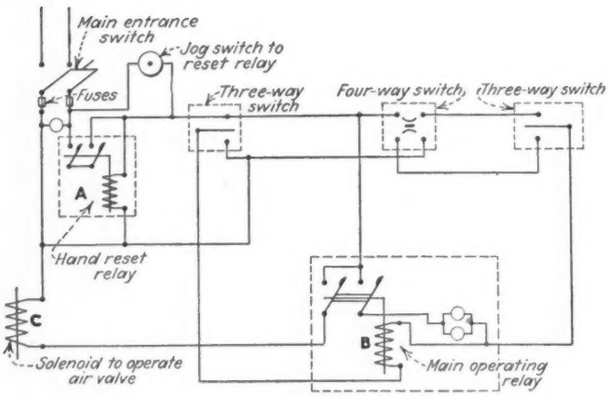


Fig. 2—Wiring diagram for electrically controlled air-operated doors

ally expanding into the air cylinder and continuing the motion of the door, but slowing it down so that the movement is comparatively slow and without banging. The final air pressure is about 11 lb. When the door has fully opened or closed the pressure again builds up in the receiver and air cylinder to 105 lb.

A safety device used with this door is a system of green lights which flash on as soon as the solenoid has operated the valve to open the door. This is accomplished by an arm fastened to the valve piston rod. When the valve is in the open-door position, this arm completes a circuit that flashes the green lights. Another safety feature pointed out in a previous paragraph is the relay which is thrown out when the power goes off, this opening the circuit and the door and keeping them open until reset.

Considerable trouble was experienced when the first installation of this electrical control was made. At that time a switch was used which was placed a few feet from the door, on each side, so that pedestrians could operate the door. No man doors were provided. Occasionally it would happen that a man would throw the switch, to open the door, so violently that the switch would make contact and then fall away from the points. This would open the door, but the door would immediately reclose. A couple of men were almost caught in this manner. The relay *B* (Fig. 2) overcame this difficulty. On another occasion two men had opened the door with the switch for use of pedestrians and were going through when the door suddenly began to close, this occurring after the installation of relay *B*. This condition was caused by another man coming along and throwing the motorman's switch, about 175 ft. from the door, at practically the same time as the first men threw the nearer switch. Some complaint had been made about trouble when men were coming and going through these doors, and I happened to be there. The second man received a safety lecture. Signs were placed at motormen's switches reading "This switch for use of motormen only." No further trouble was experienced in this respect, but to insure safety man doors were provided at every point where a mechanically operated door was in use.

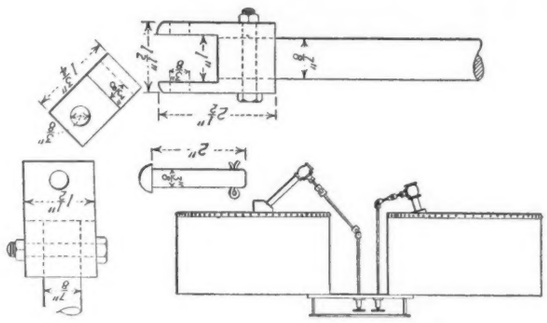
One other trouble was experienced, which resulted in two smashed doors, but it occurs only rarely now. The switch would be thrown, to open a door, and the door would not open. If the motorman was running carefully, as he should, he would have time to stop his train. This occurred at times when doors had not been in operation for some time, such as between shifts. We came to the conclusion that the the air valve was receiving too much oil and that this filled the space between the end of the cylinder and the piston, creating such a high vacuum that the counterweight was not heavy enough to operate the valve. This weight could not be increased, or the solenoid would not lift the valve piston. Closer attention to the lubrication of this valve has practically overcome this trouble. One other reason for installing the man doors was that several times men were caught behind the main doors when they stuck and could not get through.

We have reason to be entirely satisfied with these doors as now designed and with their operation. Furthermore, the train men are well pleased and freely express their appreciation of the door.

Universal Joint for Valve Rods

By Charles Labbe
Clarkdale, Ariz.

In a concentrate cyanide treatment plant where solutions had to be drawn from tanks the outflow from three tanks was controlled from a convenient place upon a platform. Rods leading from handwheels to valve stems under the tanks were connected by home-made universal joints of simple construction. The long connecting rods were made of $\frac{7}{8}$-in. round iron. Both upper and lower parts of the universal joints were made of



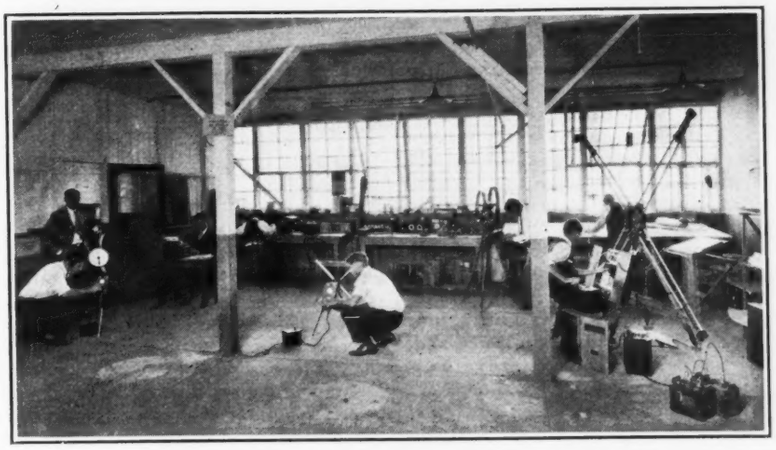
Details of a universal joint for valve rods

$1\frac{1}{2}$-in. square iron about $2\frac{1}{2}$-in. long, drilled as shown in the sketch, fitted to the rod, and held by $\frac{1}{4}$-in. bolts. The middle piece is made of 1-in. square iron, held by $\frac{3}{8}$-in. rivets with cotter pins. To cut the slot, a 1-in. hole is drilled and the slot completed by a hacksaw. The universal joint is fastened to the valve stem by a $\frac{1}{4}$-in. bolt. By using two universal joints a range of angle and direction can be easily obtained that will reach any valve under a tank.

Errata

A valued contributor, Mr. A. D. Rood, directs attention to the fact that in his table for chord distances printed in the issue of Nov. 12 the caption is in error, in that the distances are for curves of 60-ft. radius—not 60 deg., as stated. Also, the head over the first column of figures should have read "minutes," not "feet." Readers who have preserved this useful table for reference are requested to note thereon the corrections that are indicated here.

Industrial Progress



The geophysical research laboratory of the Radiore Company, in Los Angeles

Research Important in Developing Geophysical Prospecting Methods

THE part played by research in the development of an enterprise is insufficiently realized by many. The finished product, process or method is generally advertised, but not the arduous investigation that has made it possible. Success may have its explanation in the sound research that has been done. This is as true of geophysical prospecting as of any other work.

An organization active in the field of geophysical prospecting in recent months is the Radiore Company, whose headquarters are in Los Angeles. Together with other firms engaged in this class of work it has been in the mining public's eye, largely because of the current interest in geophysics. But less well known than its activity in the field is the fact that it has a research staff continually at work in a well-equipped laboratory in Los Angeles.

The board of directors of this company is composed of L. C. Penhoel, B. M. Snyder, A. B. Menefee, H. Olund, Edward Thornton, and E. J. Atkinson. Mr. Menefee, acting under Mr. Snyder, is in charge of the company's operations. Prior to coming with the organization he was manager of the Replogle Steel Company's mine and concentrator near Dover, in northern New Jersey. He has also had considerable experience in mine valuation and geological work.

The laboratory at Los Angeles and the entire research program are supervised by J. J. Jakosky in his capacity as consulting engineer for the company. It was Mr. Jakosky who was in charge of the underground communication laboratories of the Bureau of Mines at Pittsburgh a few years ago, when it was conducting studies of various subjects such as the propagation of radio waves through the earth; the effects of sheet water; the various types of conducting strata; and the so-called wired wireless. Subsequently he developed the radio interference correction equipment now used as standard by the Western Precipitation Company in eliminating the radio interference caused by the operation of the high-voltage electrical precipitation units. Mr. Jakosky is a technical graduate—as a mechanical engineer, of the University of Kansas; as an electrical engineer, of the University of Pittsburgh. He also has done graduate work at Carnegie Institute of Technology.

It was a little over two years ago that the company became interested in geophysical work. At that time it undertook and for eighteen months conducted field research work at mines in California for the purpose of developing a process using radio waves. This work was done under the direction of Messrs. Menefee, Olund, and E. H. Guilford. Mr. Guilford is now in charge of the company's eastern office in Montreal and, as chief engineer of its electrical surveying division, is also in charge of the field parties at work in Canada.

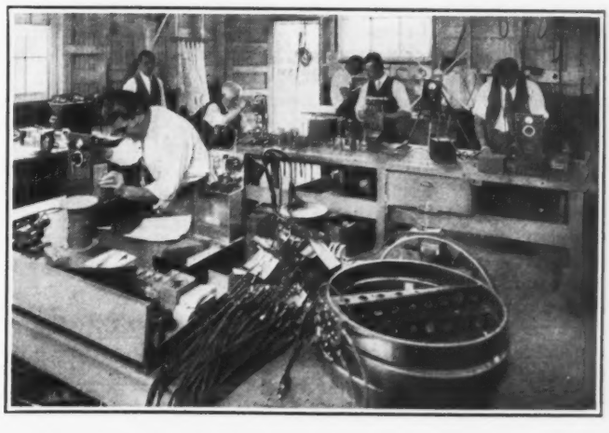
While the preliminary work was going on in California Mr. Jakosky was making a mathematical and theoretical study of the phenomena noted. His investigation was really an outgrowth of the work which he had previously been doing for the U. S. Bureau of Mines. About eight months ago on the completion of the field work and theoretical studies the first commercial work was undertaken. Since then the company's force has grown from six to forty men.

Views of the research laboratory and the shop connected with it are shown in the two accompanying cuts. The research force under Mr. Jakosky consists of three technical graduates who are engaged on major problems, with such assistants as are required. One of the chief of these problems is the study to correlate the effects of electrical conductivity, current distribution, type of mineralization, and related factors, the interesting relationships of which will be published in the pages of *Engineering and Mining Journal* at an early date. Another major study is that of wave propagation with special reference to distortion of wave front, effects of sheet water and moisture in the soil, and other conditions obtaining underground.

Still another problem and one that has been worked out with promising results is that of the development of a very small, easily portable equipment, which can be handled by a two-man crew and which is intended for rapid reconnaissance and examination work. This equipment is so small that it can be taken in by dog sled or airplane to heretofore inaccessible areas such as exist in northern Canada and Alaska.

The Los Angeles research laboratory is considered one of the best-equipped high-frequency laboratories on the Pacific Coast in respect to measuring and calibrating apparatus. It also has a trained shop personnel.

Since undertaking commercial work the company has completed about thirty contracts to date in the United States and Canada. It has eight crews of four men each, all of the crew chiefs and over half of the field personnel being technical graduates in mining, geology, or civil engineering. The company conducts a training course in field and theoretical work for its new men.



The geophysical laboratory has as an important adjunct the well-equipped shop shown here.

Solid Gears Supplanting Split Type

AS A RESULT of the advance in metallurgy and in heat-treating processes, the split-type gear for industrial and railway haulage motors is fast being replaced by solid gears. Many progressive companies are equipping their cars entirely with solid gears.

The chief advantage of split gears, that of renewal without removing the wheel, no longer exists, as modern, heat-treated gearing lasts as long as the wheel, and usually longer. When it becomes necessary to change a wheel, it is a simple matter to change the gear at the same time. Standard axles are provided with a raised gear fit, which makes it unnecessary to press the gear over the wheel fit to assemble the gear in its proper position.

It is usually impossible to obtain a well-balanced split gear because of the necessity of providing ample wrench clearance for assembly and of locating the bolts where they will have the greatest clamping effect. Bulky bosses are required to insure proper bearing surfaces for the bolt heads and nuts, and result in an unbalanced gear consisting of light and heavy sections.

Split gears, moreover, present unusual heat-treating difficulties. The invariable result is a distortion which necessitates grinding of the tooth profiles to remove high spots and to insure satisfactory operation. This grinding operation results in approximately 30 per cent of the increased cost of split gears over that of gears of the so-called solid type.

Split gears are used mainly in the export field by operators who usually specify the exact measurements. To produce such gears, it is necessary to grind not only the outside diameter, but also the tooth profiles, involving a further increase in cost.

With the solid gears, grinding of the outside diameter is unnecessary, except to provide a means of checking the measurement, according to General Electric. Every gear it makes is tested on proper center distance with a master pinion known to be correct in tooth form and spacing. Should the gear be noisy during this test, the tooth profiles are trued by means of an involute grinding wheel. The gear is again tested and, unless it operates satisfactorily, it is scrapped. Concentricity of bore and pitch line, one of the essentials of quiet gearing, is insured by the final boring operation which is performed in a chuck which centers the gear from the pitch diameter.

With the outside diameter left unground and eccentric with the bore and pitch line, it is natural that the measurements across the outside diameter should vary. Hence, the tooth thickness cannot be checked by means of the usual tooth verniers, because with the depth slide of the instrument set at the proper corrected addendum, measurements would not always be taken at the true pitch line.

Removing Magnetic Material From a Glass Sand

AN UNUSUAL method of separating from glass sand all magnetic material, such as hematite, magnetite, ilmenite, minute particles of iron abraded from the surfaces of crushers, screens or other iron machinery and even particles of iron attached to sand crystals, or entirely included in them, has been installed in the plant of the United States Silica Company of Ottawa, Ill. The process, which is used in the manufacture of a sand of extremely low iron content necessary to meet the requirements of glass manufacturers where the color of the glass is of importance, has been developed in order to submit large quantities of sand to the highest possible magnetic intensity. It makes use of a large capacity magnetic pulley with the material passing directly over the bare face of the pulley instead of over a belt as is the usual practice.

The sand which is originally obtained by the disintegration of a high grade sandstone is first submitted to intensive washings which eliminate the alumina and other non-magnetic materials contained. The sand is then fed by gravity from a large hopper in a thin stream, directly onto the bare face of a 48-in. Dings magnetic pulley on which the maximum current is carried. All particles of magnetic material adhere to the face of the pulley.

To remove the magnetic particles collected on the face of the pulley a special control mechanism demagnetizes the pulley for a few seconds, approximately once every minute. At the same time a stiff brush extending the full width of the pulley is brought to bear against the pulley face on the back side. This brush, operating while the pulley is demagnetized for a second or two, removes all magnetic particles which have been seized, the collected magnetic particles falling into another chute. Approximately 75 tons of sand per hour are handled by the separator.

A Safe Trolley Tap

A new trolley tap is said to have safety features which prevent operating loss to the company and injury to the man on the job. It is made by the Ohio Brass Company.

A simplified device, it is so constructed that it offers no chance for the hand to come in contact with a live hook. It is equipped with protective handguards. Furthermore, dowel pins on each terminal fit like a tongue in a groove which runs the length of the holder. Terminals and fuse element are kept from turning and twisting inside the case, so that the contact lips of the fuse cannot be twisted off. The fuse is renewable and is powder packed so that the blow-out arc is smothered. Thick insulation provides maximum safety. The tap is heavy enough, without being bulky or cumbersome, to stand up well under the hard treatment mine equipment usually gets.

A new trolley tap

Motor Takes Low Current on Starting

A motor recently introduced, which is built in sizes from ½ to 30 hp. and for either 2- or 3-phase, 60-cycle current, is so designed that it can be started directly across the line without the use of a starting compensator, starting resistance, or other voltage reducing mechanism, and with starting current below the requirements of the National Electric Light Association. This is the so-called "Switch-Start" motor made by the Lincoln Electric Company. The chief claim made for it is that operating characteristics, such as power factor, efficiency, maximum torque, and temperature rise have not been sacrificed to secure low starting currents. On the contrary, equal or better efficiency and a power factor from 5 to 10 points higher than the ordinary self-start motor are claimed for it.

A New Jack

A 75-ton jack, weighing only 200 lb., has recently been introduced. Its collapsed height is only 18 in. which is low enough for practically any job. It has a 10-in. lift, giving a total height of 28 in. It is equipped with two pumps: a speed pump to raise the plunger to the point of contact; and a power pump to raise the load. The maker is the Blackhawk Manufacturing Company of Milwaukee.

The jack will lower its load, quickly or slowly, as desired, and is under control at all times. The load may be raised or lowered a fraction of an inch to a desired point. The release valve is entirely separate from the pump and prevents accidental lowering. All working parts are built on the outside. A feature is the check valve unit. This contains both ball checks and is the heart of the jack.

Machinery Exhibit for Liege

The centenary of the independence of Belgium will be celebrated in 1930 by imposing manifestations. Among these will be an international exhibit of sciences and of industries using heavy appliances, at Liege. The tentative program includes exhibits showing the advance and present status of mineralogy, geology, and paleontology; metallurgy and mechanics; and mining and quarrving.

In 1905 the Liege Exhibition met with great success. In unique surroundings 30 nations co-operated to display the products of their industries.

NEWS OF THE WEEK

Summary

FROM 30,000 to 40,000 inquiries concerning the common metals are received annually by the U. S. Bureau of Mines, and an effort will be made to increase the amount of such information readily available at the Bureau.

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Plans under consideration for the resumption of operations on a large scale in the lead-silver camp of Eureka, Nev., include the financing of the Eureka-Nevada railroad and the erection of a smelter.

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An analytical study of the economics branch of the U. S. Bureau of Mines is being made by J. E. Spurr in the hope that suggestions may be made for increasing the usefulness of the branch to industry.

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Reorganized Tornado company plans to explore thoroughly the Tornado property in the Dripping Springs district of Gila County, Ariz., on which a high-grade gold strike was made last spring.

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Statistics for Mexico indicate a decrease in the production of gold and antimony during 1927, and an increase in the output of silver, lead, copper, zinc, arsenic, mercury, and graphite.

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U. S. Bureau of Mines and Carnegie Institution make progress in dealing with research problems of considerable importance to operators in the Michigan copper district.

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A new find is made in a drift on 1,400 level of the Shattuck Denn property in the Bisbee, Ariz., camp.

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Joplin-Miami district now boasts a mill equipped with steam radiators for heating purposes.

New Railway Shortens Shipping Route for Katanga Copper

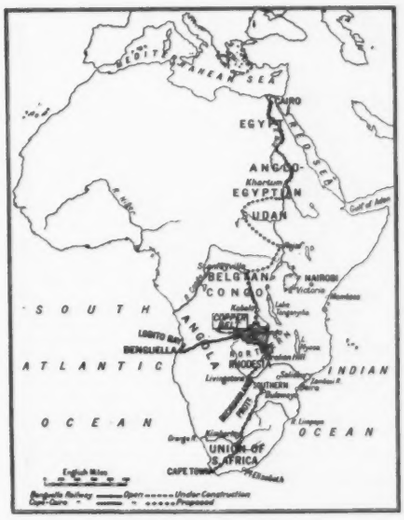
Benguella Line, Completed to Belgian Congo Border on Nov. 27, Will Reduce Transport Distance of Union Minière's Production and Supplies by 3,000 Miles

By George L. Walker
Special London Correspondent

THE Benguella railway, built primarily to serve the Union Minière du Haut-Katanga copper mines in Africa, was completed to the Belgian Congo border on Nov. 27. Its importance is that it will shorten the distance that Union Minière's production and supplies must be transported by over 3,000 miles, thus bringing these great copper mines approximately one month nearer the world's markets. This line is the result of the foresight of Robert Williams. Immediately after securing a concession to explore and develop the copper deposits at Katanga, Mr. Williams gave his attention to the future transportation needs of the great mines he felt sure he would be able to develop. The first deposits to be developed were then some 300 miles from the nearest railroad, at Broken Hill, in Northern Rhodesia, and a similar distance from a point to which supplies could be brought in via the River Congo water and rail route. His two companies, Tanganyika Concessions, Ltd., and Zambesia Exploring Company, Ltd., both large holders of Union Minière shares, financed and built 136½ miles of railroad from Broken Hill to the Congo Border. Union Minière extended this line to the mines and thence on to Bukama, on Livingstone's Lualaba River. This construction gave Katanga transportation facilities which permitted the mines to be equipped and operated productively; but the copper properties were still some 8,700 miles from England, via Cape Town, of which over 2,300 miles were by rail in Africa. Beira, on the East Coast, was 1,625 miles nearer by rail, than Cape Town, but this routing called for over 8,000 miles' shipment by water, via the Suez Canal and Mediterranean Sea. The River Congo route was unsatisfactory because of the necessity of transferring freight from boats to railway cars and back again to boats three times before tidewater was reached.

An age-old slave trail ran almost directly west to Benguella, on the Atlantic Coast only 1,200 miles away, and a few miles to the north of Benguella was a great landlocked harbor, Lobito Bay. Having obtained the necessary concession from the Portuguese government in 1902, Mr. Williams started to build the Benguella railway over this route. There were engineering difficulties to be overcome, but he soon found these to be the least of his troubles.

One group obstructed the work in an effort to rob him of his concession, another in an attempt to prevent the future diversion of valuable freight business, and a third by claiming that such a railroad was unwarranted. These obstructions had hardly been swept away when the war came along and stopped construction work for nearly eight years. But in the meantime the vastness of the copper deposits at Katanga had come to be recognized and the need of the Benguella railway was evident, so the capital was readily obtained for the completion of the road.



Sketch map showing construction status of Benguella railway

About 460 miles of road remain to be built by the Belgian Congo government to connect the Benguella railway with the Katanga railway. For nearly half its length this connecting line will traverse Union Minière's western cop-

per-mining region, in which there are over 100 ore deposits that heretofore have been without transportation facilities. Materials for its construction will go in over the Benguella railway and it should be completed in two or three years. This railroad will greatly hasten the development of Central Africa's mineral resources. It will reduce the cost of Union Minière's copper approximately 1½c. a pound and give the company the transportation facilities which are essential to the doubling of its present production. Branches undoubtedly will be extended later to the mining districts which are being developed in Northern Rhodesia.

The Benguella railway will provide the first rail connection across the continent of Africa from the Atlantic to the Indian Ocean. It will give central Africa, an interior region where vast mineral resources exist, a direct outlet to the West Coast—to an excellent harbor on the Atlantic Ocean only 4,900 miles from Southampton, England. It not only will expedite the movement of freight and reduce transportation expenses, but will save weeks of time to every visitor to central Africa.

Union Minière du Haut-Katanga is already cramped for transportation facilities. Now that its reverberatory furnaces are in commission, and its production thereby increased, it will need 100,000 tons more coal yearly and other supplies in similarly larger proportion. This expansion of its needs for transportation facilities comes at a time when the existing railroad to the south and east coasts is being further congested by the rapidly increasing development and equipment of mines in Northern Rhodesia. In view of this situation it is probable that the construction of the Belgian Congo connection with the Benguella railway will be expedited.

Two Properties Sold in Joplin-Miami District

The Childress Lead & Zinc Company has purchased the Northern mine from the Commonwealth Mining Company, in the Joplin-Miami district. The consideration is unofficially reported at $100,000. The Northern mine was purchased from Neff, Cole, and associates in 1925 for $125,000, by the Commonwealth company, of which J. W. Perry, of Kansas City, Mo., is the president and principal stockholder. His company still has two mills in the field, both of which are idle at present. The Childress company is headed by Frank Childress, of Joplin, and also owns and operates the South Side, Fox, Fort Worth, and Whitebird mines. The Northern mine will be actively operated by the new owners. It has been producing about 150 tons of concentrates a week, much of which is lead.

R. M. Atwater, Jr., president of the Interstate Zinc and Lead Corporation, has appealed to the operators of the district to hold down production for the first three months of 1928 to not more than 10,000 tons per week, in order that the 35,000-ton surplus may be eliminated. He estimates that over-production cost the district not less than $7,000,000 during 1927, by reason of poorer prices for zinc ore than would have existed had there been no surplus in bins.

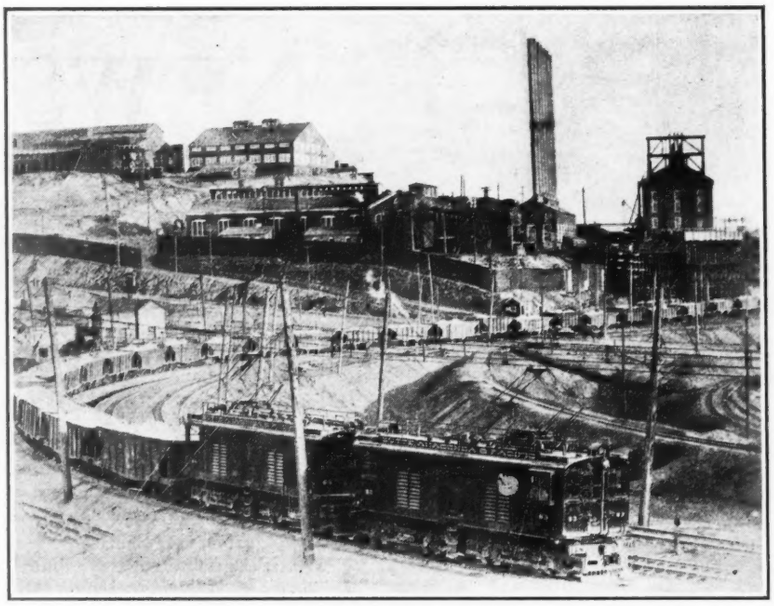
Temple Chapman and L. C. Church have sold the 120 acres of land on which is located the Chapman and Bilharz No. 3 mills to Fred Childress, Joe Wingert and Al Heggem. The consideration was not made public. The Bilharz mill has been idle for some time but will be opened again shortly after the first of the year, according to a current report.

The Velie Mines Corporation expects to complete its new Leopard mill, located west of Baxter Springs, Kan., about the middle of January. It is of steel construction throughout. Three shafts have been put down on the lease and the ground will be well opened by the time that construction of the concentrator is finished.

Montana Mines Completing Mill in Ruby District

Twenty carloads of machinery were recently delivered at the property of the Montana Mines Company in the Ruby district, near Patagonia, Ariz. The company, which is a subsidiary of the Eagle-Picher Lead Company, has a 250-ton mill under construction, and most of the machinery is equipment for the mill.

About 110 men are now employed at the property, the majority of them working in the mine. Diamond drilling to a depth of 1,200 ft. is also in progress, and it is expected that operations on a production basis will begin next March. Frank Lerchen is manager of the property.



The Never Sweat mine of the Anaconda Copper Mining Company

Anaconda Removes Stacks at Never Sweat Mine

In nearly all photographs of the richest hill in the world, which is situated at Butte, Mont., the seven smokestacks of the Never Sweat mine of the Anaconda Copper Mining Company stand out in the foreground. These seven stacks are now being removed, as the company is no longer using steam. The mine was one of the first located in the Butte camp, and received its name as follows: When the locators of the claim appeared before H. S. Clark, who was then clerk and recorder in the district, they offered him an interest in the claim for his recording fees. He asked them the name of the claim, and they told him that, although they had worked on the tract all winter, they had not as yet named it. They then asked him to suggest a name. He said, "Have you worked hard all winter?" and they replied, "We work hard but never sweat much." He then suggested that they name the claim the "Never Sweat."

The surface plant at the mine, and a loaded ore train traveling down Anaconda Hill are shown above.

To Reopen Poland Mine in Big Bug Canyon

The old Poland mine in the Big Bug Canyon, near Mayer, Ariz., is to start operations again soon. According to recent estimates, there is approximately 77,000 tons of milling ore on the dumps and 100,000 tons blocked out underground. The old Poland has a production record of over $750,000, and was owned by the late Frank Murphy and E. B. Gage, who organized the Poland Mining Company. The ore was rich enough to enable the owners to haul it to Flagstaff for shipment to San Francisco. The mine was shut down in 1907.

Research Work of Value to Michigan Copper District

Quincy Hoisting 1,000 Tons Daily—Calumet & Hecla to Increase Production From Depth

TWO phases of research work in the Michigan copper district have been given attention by the U. S. Bureau of Mines and the Carnegie Institution of Washington, D. C. One phase relating to rock subsidence, in charge of W. R. Crane of the Bureau of Mines, is important to the deep mines of the district. His findings are expected to be of value in deep mining work and possibly in solving the mystery of so-called air-blasts. The work, which also has taken him to the iron districts, will not be completed for some time. Another phase, involving delicate tests of the electrical conductivity of the earth's surface, has been carried out by representatives of the Carnegie Institution, who employed new instruments devised by the Institution. They were able to determine the thickness of overburden, or glacial drift, which determination is of importance in the planning of diamond drill operations.

Quincy Hoisting Average of 1,000 Tons a Day

Quincy, which has a normal force in No. 6 shaft, now its only producing unit, is hoisting an average of 1,000 tons of copper rock daily, a rate that probably will prevail until No. 2 shaft is repaired. No. 6 is in good ground, with considerable mass copper in the lower levels. The shaft is bottomed at the 87 level, where a station is being cut preparatory to crosscutting to the Pewabic bed. In No. 2, where fire damage is being repaired, retimbering is proceeding below the 42 level. Progress toward the 53 level, where the fire centered, will be slow on account of the amount of rock in the shaft.

Mayflower-Old Colony has just cut through another amygdaloid lode in its long crosscut west from the 1,700-ft. level of the shaft. It was 15 ft. in width, but contained only minute particles of copper. The crosscut is in more than 3,200 ft. One vein, 2,000 ft. from the shaft, has been opened for a total distance of 800 ft., but results in this instance were rather discouraging.

C. & H. Mining at Depth

The greater part of the tonnage from the conglomerate department of Calumet & Hecla Consolidated is coming from openings above the 81 haulage tunnel, but production from below this level, which is equipped to mine the conglomerate bed at great depth, will gradually increase as drifts are extended. Except for a small amount from No. 4 shaft, Calumet branch, the only ore now being handled below the 81 level comes from No. 7 Hecla, in which the 81, 82, and 83 levels are being stoped. Drifting is proceeding in several levels below the 83. No. 4 Calumet, which is bottomed at the 93 level, is being prepared for resumption of mining at depth. This shaft, which was damaged by fire several years ago from the 56 level upward, has been retimbered to the 44, some rock being hoisted as repair work proceeds. Repair of the shaft to the 56 level will permit of the mining of rich arches and backs of stopes from there to surface. In the shafts of the South Hecla department and in No. 6 Hecla, pillars and arches are being removed, yielding high grade copper rock.

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Tornado Company to Explore Gila County Property

A hoist and compressor are being installed at the Tornado mine in the Dripping Springs district of Gila County, Ariz. A 300-ft. shaft is to be sunk, and then crosscutting will be started at vertical intervals of 100 ft. The property was the scene of a high-grade gold strike last spring, and, with Weepah and other places where gold rushes occurred at that time, received considerable publicity. There was much excitement at Dripping Springs and many claims were staked. The Tornado company was organized and some stock was sold at that time, but no actual mining was done. The camp was gradually deserted, and has remained so until the recent resumption of operations. The company has been reorganized, and under the leadership of E. T. Hazelett, president, and Dan H. McGraw, discoverer of the bonanza, it is planned to explore the property thoroughly to a depth of 300 ft.

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New Find Made in Shattuck Denn Property

During recent operations on the Shattuck Denn property, in the Bisbee camp, a drift on the 1,400 level going north has been following a 4-in. vein of chalcopyrite, which has been rich enough to bring the average of the entire drift up to about 3 per cent copper. The stringer has been followed for about 70 ft., and in some places it widens out to 15 in. It is in the porphyry entirely at present, but a change is expected as soon as the drift reaches the contact of the porphyry with the limestone. The 12-in. band of ore on the 2,000 level, which carried lead and copper, seems to extend along the top of the drift for a short distance and then goes above the drift, which is continuing towards the winze previously sunk in the ore found on the 1,800 level. After connection is made with the winze, so as to restore ventilation, a raise will be put up following this stringer of ore.

At present, there are five drifts going ahead in Denn ground, all of which have excellent prospects of finding ore. Likewise, several drifts from different points in Calumet & Arizona ground will prospect C. & A. ground in the vicinity of Denn side lines. The drift from the Denn shaft to prospect the Dividend fault, which struck a heavy flow of water about a month ago, is now going ahead, and large boulders, rich in lead, are continually being encountered.

Operations Resumed at Several Nevada Mines

Broken Hills Property Optioned—New York Syndicate May Erect Smelter in Eureka Camp

THE Broken Hills mine, at Broken Hills, near Quartz Mountain, Nev., formerly a plaything of George Graham Rice, has been optioned to Ed Bevis and Zeb Kendall. The property has been partially developed to a depth of 350 ft. by a shaft and lateral workings at various elevations. Part of the shaft is inclined and the remainder vertical; the bottom portion is in poor condition. Former production, which was mostly high-grade silver-lead ore, probably did not exceed $150,000 in value. It is claimed that there is good-grade ore in the bottom of the shaft. The present option holders are preparing necessary surface buildings and repairing the shaft in order to thoroughly investigate the deeper levels.

Extensive Development Planned in Gold Circle District

It is reported that during 1928 extensive development work will be carried on in the various properties of the Gold Circle Consolidated Mines Company in the Gold Circle district. The work is to be started during the current month. The Elko Prince shaft is to be retimbered to the 600 level, which work on completion will make several orebodies accessible for stoping. New work is to be started on the Rex and Colorado Grande properties, and a new shaft is to be sunk at the Grant-Jackson mine. Most of the tonnage for the 100-ton cyanide plant, which has been in operation since last May and shipping bullion at the rate of $35,000 monthly, has been mined from the Grant-Jackson and Missing Link properties. Leasers on the Rico property of the Gold Circle Consolidated, adjoining and near the south end of the Missing Link, have uncovered an 8-in. streak of high-grade gold ore which they have developed for 20 ft. on its strike.

Activity Expected at Eureka

Mining in the old bonanza lead-silver camp of Eureka has been very quiet, but favorable reports of an early resumption of work in some of the old properties are current. F. L. Torres, president of the Eureka Smelting Company, states that that company's financial affairs have been readjusted and that a New York syndicate is prepared to finance the Eureka-Nevada railroad, build a smelter, and resume mining operations on a large scale. In the properties of the U. S. Smelting, Refining & Mining Company, which include the Richmond-Eureka at Ruby Hill, and the Diamond and Excelsior mine, which is now held under lease, there are only a few leasers at work. The company, however, has recently had engineers on the ground and it is expected that with a rising market on lead and silver new work will soon be started on company account.

Gold Ore Company Working Three Shifts at Oatman

Work in the two new shafts of the Gold Ore Company at Oatman, Ariz., is being conducted on three shifts. The shaft on the Brooks property, west of the Goldroad mine, is halfway to the 300 level, where a station will be cut and crosscutting started. The work being done on the new Aztec shaft consists of raising from the 200-, 400- and 600-ft. levels of the Black Eagle mine. About half the raise work has been completed. After the pilot raise is finished from the 600 level to the surface, it will be widened into a two-compartment shaft and timbered. It will then be sunk to the 1,000 level. The high-grade orebody on the 700 level of the Aztec mine corresponds to the 1,000 level of the Black Eagle. It will be exploited from the new shaft, use of which is expected to make transportation costs much lower than they have been. Production from the Aztec mine has been stopped, pending the completion of the shaft, and the Tom Reed mill has been shut down. The mill will soon resume operations, however, to take care of production from the Western Apex mine where stoping has just been started.

Federal to Increase Depth of Morning Shaft

The Federal Mining & Smelting Company, which owns the Morning mine at Mullan, in the Coeur d'Alene district, Idaho, recently let a contract to sink the shaft on the property an additional depth of 400 ft. The shaft is now down to what is known as the 3,050 level, which is 2,250 ft. beneath the hoist station on the main operating tunnel level. As the present depth of the shaft is practically the limit of the hoisting equipment now in use, a new electric hoist with an additional 1,000-ft. capacity will be installed. Ore on the three deepest levels at the Morning mine has proved to be of better grade than in the workings above, and the orebody maintains the dimensions of the upper levels, averaging 12 ft. in width and 1,500 ft. in length.

Recent Developments at California Properties

In Plumas County, Calif., the G. & L. Mining Company is reported to have discovered an orebody on claims adjoining the Walker mine. The Hess mine near Alturas, Modoc County, has been leased by N. N. Getchell. At Grass Valley mining claims have been transferred by the Contention Mining Company to the Empire Mines and Investment Company. South of Grass Valley the Ben Hur Divide Mining Company is preparing to explore the Alaska claims. The Western Merger Company expects to complete the construction of a small mill in January on its Randolph claims. A milling plant is reported to be under construction by the Gold Mountain Mines Company on the Cherry Hill claims west of Williams, Colusa County.

Rapid progress is being made in the construction of a 9-cu.ft. gold dredge near Junction City on the Trinity River, under the supervision of E. L. Smith, manager of the Madrona Gold Dredging Company. It is expected that the wooden hull will be completed and that the machinery will be in place by next June. At French Gulch, three properties are active, the Niagara, the Sybil, and the Milkmaid. At all three properties exploration work is in progress.

The Yellow Jacket mine, in the Alleghany mining district, has been reported sold to the Alleghany-El Dorado Mining Company. Purchase of the Erin-Go-Bragh prospect, near Sonora, by G. E. Theda, F. A. Russe, and M. E. Waggoner is reported. A blind vein has been struck in the crosscut tunnel of the Comanche Mining and Reduction Company's property near Benton.

The Tacoma Mining Company, operating the Prouty mine in New Year's Diggings, Mariposa County, has completed the installation of 2,500 ft. of 12-in. pipe for hydraulic mining. Gladding, McBean & Company have opened up a new clay pit near Whiterock, and are hauling the clay by auto trucks to their plant at Lincoln. The La Grange Gold Dredging Company has nearly completed a gold dredge on the Ivet property between Merced Falls and Snelling. A large acreage is controlled by the company at this point.

Common Metals Divison to Increase Information Available

Actual Number of Inquiries Varies Between 30,000 and 40,000 Annually—To Conserve Time of Experienced Personnel —Field Missions to Be on Definite Assignments

By Paul Wooton
Special Washington Correspondent

ONE-THIRD of all inquiries reaching the Bureau of Mines pertain to the common metals. The actual number varies between 30,000 and 40,000 annually. Because this represents a concrete demand well scattered through the industry, the newly created common metals division is concentrating on an effort to increase the amount of mining information which will be readily available.

A survey of the data which is reasonably accessible to the Bureau indicates that 95 per cent of it already is available, or can be made so without great delay. It is estimated that the remaining 5 per cent of the fundamental data necessary to meet the demand for mining information will require more effort to secure than did the other 95 per cent. As the material becomes available it is being filed and indexed in an improved way.

So as to conserve the time of the P-4 personnel (those receiving from $3,800 to $5,000) they are being relieved of all routine or other duties which can be performed by personnel in the P-2 ($2,400 to $3,000), or the P-3 ($3,000 to $3,800) classes. In this way the entire time of the experienced engineers and geologists may be devoted to the duties that others are not qualified to perform.

A new policy also is to be applied to the field work on the common metals. All missions into the field will be on definite assignments, so that the gaps in the present supply of information may be filled systematically. In like manner, in co-operation with the Bureau of Foreign and Domestic Commerce, world data will be built up along carefully planned lines.

In connection with the expanded program of the Bureau of Mines for the study of potash minerals, one of the largest oil companies in the Southwest has given permission to use such of its wells as are suitable for experiments on potash extraction by solution. When the laboratory work at the New Brunswick station is advanced somewhat, actual leaching operations will probably be undertaken in the field.

Commissioner Johnston B. Campbell has been elected to serve as chairman of the Interstate Commerce Commission for 1928. It is the policy of the commission to rotate the chairmanship from year to year in the order of seniority of service.

Analytical Study of Economics Branch in Progress

An analytical study of the work of the economics branch of the Bureau of Mines is being made by J. E. Spurr. The survey is being made in the hope that suggestions may be developed for increasing the usefulness of the branch to industry. If the funds are made available, Bureau officials hope to make a start on more effective services to the producers of minerals and metals. This would include periodic surveys of production, consumption, distribution, stocks, and markets, patterned along the same general lines as the existing statistical service for the coal industry. Mr. Spurr is acting in an advisory capacity to the director in making this study. Other specially qualified persons will be asked to consider the situation and make recommendations to the director which will guide him in the further reorganization of the economic branch.

Montana Events Include Several Legal Suits

Testimony Completed in Apex Claim of Midwest Development Company Against Butte West Side

ALL OF the testimony has been taken in the apex suit of the Midwest-Butte Development Company against Butte West Side Mines Company and Mines Merger Corporation. The suit involves ownership in the Minnie Jane claim. Testimony was taken by Federal Judge George M. Bourquin. Experts for the plaintiff were Samuel Barker, Jr., Clinton J. Hansen, and George Bennett, and for the defendant R. N. Hunt and H. D. Morse.

North Butte stockholders are attempting to set aside receivership and return the company to stockholders. Federal Judge Bourquin has disqualified himself, and the hearing will be before Federal Judge Charles N. Pray, of Great Falls.

At a hearing held at Kalispell, Mont., before a representative of the Federal Water Power Commission, one of the attorneys of the Montana Power Company, which desires to take over the Flathead water-power project, stated that the Anaconda Copper Mining Company expects to produce aluminum at some future time by means of an electrolytic process.

Butte Copper Consolidated Mines, after planning to crosscut the known orebodies at its Joe Dandy mine, Radersburg, from the 160-ft. point in its new vertical shaft, has decided to sink the shaft to the 250-ft. point before crosscutting. At that level the main orebodies of the four known ones will cut the new shaft. In the meanwhile shipments are going forth steadily from the old workings.

Anaconda Copper Mining Company has donated to the Montana State School of Mines a large new relief map of Montana, made by F. A. Linforth, assistant chief geologist. The map is made of a special kind of plaster, and is 13 ft. long and 7 ft. high, all parts being made to an exact scale. It is planned later to add the surface geology to the relief.

That the mining business is conducive to health and longevity is evident by the fact that Jake Esches, 96-year-old prospector, still performs his annual assessment work on a claim staked in 1895 on Grouse Mountain near Troy, Mont. He has been assisted in this work by a daughter and son, 75 and 74 years old respectively.

A contract has been let by the Broadwater Consolidated Mines Company, for the driving of a tunnel 3,000 ft. on the Mountain Chief property. The tunnel when it is completed will give an added depth of 700 ft. Messrs. Paine and George Hale Brabrook, of Boston, are sponsoring the operations on the property, which is near Neihart, Mont.

John Cross, of San Bruno, Calif., has leased 80 acres in Madison County from the State of Montana. Mr. Cross believes that he has found an underground extension of the gold ore in Alder Gulch. According to newspaper reports, he is endeavoring to secure the technical and financial co-operation of the U. S. Geological Survey in his venture.

L. Lorenson, oil operator of the Kevin-Sunburst field; Daniel Tracy and W. Vande Butte, of Great Falls, are erecting a 75-ton mill below the Judge Hotel at Neihart, Mont. The syndicate will mill the ores from the Hartley dump, recently taken over from Neihart Consolidated Silver Mining Company.

B. Leyson and associates are taking out ore from the Queen and Galt properties near Neihart, Mont. They are shipping steadily and have twenty men employed.

New Callahan Mill Operates at Low Cost

The new mill of the Callahan Zinc-Lead Company at Wallace, Idaho, which was placed in operation Oct. 15, exemplifies the economy that may be attained by modern flotation methods. Constructed at a cost of $60,000, and with a capacity of 150 tons in 24 hours, this plant is run with only five men, one of whom is an assayer. Efficient design has enabled the plant to establish a record in the Coeur d'Alene district for low cost of labor per ton of ore treated.

The ore from the Galena mine consists of a fine-grained steel galena with some pyrite in a gangue of quartz and unreplaced wall rock. Lead and silver being the only valuable minerals in the ore, the milling problem is simple. Only one product, a lead concentrate which averages 30 per cent lead and 39 oz. of silver to the ton is produced. Operation of the mill is entirely by electricity with individual motors for each machine. About 160 hp. horsepower is required.

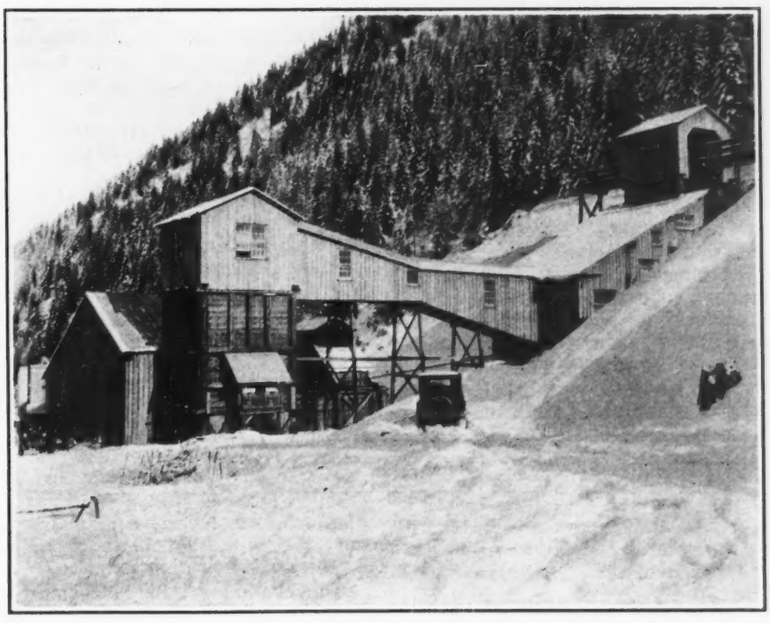
Arizona Mines Continue Important Development Work

Crosscut on 2,000 Level of Denn Mine Enters Orebody—C. & A. Completes Half-Mile Connecting Drift

THE crosscut on the 2,000 level of the Denn mine, at Bisbee, has entered a new orebody at a distance of 200 ft. from the shaft. The extent of the new ledge has not been determined, but high-grade lead-silver-gold samples have been obtained. Deepening of the shaft to the 2,000-ft. level was only recently completed, and exploration work, which will be quite extensive, has just been begun. A new 250-gal. capacity electric pump has replaced the air pump on the new station.

Connection with the half-mile drift extending from the Calumet & Cochise shaft to the new three-compartment Warren shaft of the Phelps Dodge Corporation has been made at the 1,667 level of the latter shaft, thus completing an important part of the extensive development campaign outlined by the corporation. The Warren shaft will be sunk to a depth of 2,500 ft. by the E. J. Longyear Company, after which drifts will be run to explore the surrounding territory.

J. A. Wright, who is in charge of the work at the Divide Extension Mining Company's property at Camp Belmont, reports that he has opened up a new vein showing lead carbonates and some copper at a point about 300 ft. south of the main working shaft and west of the contact vein, which has been under development for the last year.



New mill of the Callahan Zinc-Lead Company

Carlisle Mining Company, in the Steeple Rock district, east of Duncan, is planning the erection of a 100-ton mill. The old mill was obsolete and is to be replaced by a selective flotation plant.

Mexico City Letter

By W. L. Vail
Special Correspondent

Expect Statistics Will Show Reduced Output for Gold and Antimony in 1927

Mexico City, Dec. 21 — Notwithstanding the unfavorable prices of metals, especially of zinc and lead, statistics of production for 1927 will probably show an increased output of silver, lead, copper, zinc, arsenic, mercury, graphite as compared with 1926, and a possible falling off of gold and antimony. Though the principal gold camps of Mexico are practically exhausted, increased silver production is depended upon to keep gold from lagging, and it is hoped that better conditions during 1928 may invite investment in gold properties in other sections. The extremely low price of zinc and lead has resulted in the closing of many small properties, but of only few important ones.

The possibility of a readjustment of the affairs of the national railways which would enable them to make considerable concessions in rates is looked forward to as one of the brighter expectations of the new year. At present the railways are reported to be losing about $500,000 monthly. General Manager Holloway has tendered his resignation, and the appointment of his successor has not as yet been announced. As practically all the materials used in the larger mining camps are imported from the United States, including explosives, chemicals, machinery, electrical material, pipe, steel, rubber goods, and tools, the part transportation plays in the financial success of the mining companies in this country is important. Also, practically all the silver is sold through New York markets, and most of the lead and zinc goes to Europe. Transportation is therefore a vital factor in the disposal of mine products. The closing of Camp Morado, in Guerrero, was due entirely to the fact that it was impossible for the mining interests there to operate under the existing freight burdens.

Reports from Chihuahua declare that the Cusi-Mexicana mine is expected to become one of the large producers of the state. This mine is adjacent to the old Potter Palmer properties, which have paid extraordinary dividends. Existing workings are in charge of H. C. Dudley, who developed the Ahumada lead properties. The mines are located in the district of Cusihuiriachic. A zinc flotation plant is now under construction and is expected to be in operation by the middle of the summer. Active work is also reported on Los Medanos, Concepcion, Altares, Parcionera, and Margarita mines, in the district of Las Damas. The Dona Lupe is another property now being exploited by General Garcia Pena and El Cristo in the Santa Eulalia district. The general outlook for mining in Chihuahua for the coming year appears to be bright.

New discoveries of antimony in the State of Guerrero are likely to increase the production of that metal during the coming year. At present the largest producers in the republic are the Wadley smelters, in the State of San Luis Potosi.

It is stated that the zinc exports in 1927 were 6,000 tons less than those of 1926, when a total production of about 300,000 tons was reached. As a result of selective flotation, however, a large number of small properties are expected to be put in operation during 1928.

The labor law is still under consideration in the senate. It appears at this writing that a majority of the senators are opposed to the government's plan of a federal labor law, and unless action is taken promptly the measure will undoubtedly be carried over for consideration at another session. It seems also that many of the interior mining interests oppose taking the settlement of labor disputs out of the hands of local state authorities and treating them in the City of Mexico.

A rumor is current that work is to be resumed in the Totolapan district on the Majestic properties, principally owned by financiers in Kansas City. Dr. C. W. McCarty, president of the company, has just returned from a two months' absence in the United States and is leaving at once for the mines. Most of the Oaxaca camps also suffer from high transportation costs.

The Chihuahua mining chamber is still insisting upon a consideration of its exposition of reasons for a substantial reduction in taxes in order to save the mining industry of the state. Up to the present the department to which the petition was addressed has not acknowledged its receipt.

It is expected that a contract will soon be signed between the United States Smelting Exploration Company and the Angustias Mining Company whereby the former company will take over the Angustias and Dolores properties and work them on a co-partnership basis. After an examination of the properties a proposition was made by the Smelting company, it is understood, and accepted by the Angustias interest with minor modifications.

The Boleo Copper Company, operating at La Paz, in Lower California, proposes to increase its production during 1928 with the object of reducing the cost of production per ton.

The Dolores Mining Company, after a brief shutdown, encountered a new body of workable ore, and is preparing to resume operations.

The Veta Grande unit of the American Smelting and Refining Company is milling 1,000 tons of silver, lead, and zinc ores daily. Labor conditions in the camp, according to recent reports from the district, are satisfactory.

Johannesburg Letter

By John Watson
Special Correspondent

Heavy Fall of Rock Entombs Twenty-three Workers at Crown Mines

Johannesburg, Nov. 26—On Nov. 16, a heavy fall of rock in two stopes near No. 5 shaft in the Crown Mines entombed four Europeans and nineteen natives. Within a few hours, three Europeans were rescued from one stope, but a native who had been in it was killed. In the other stope a white miner named Du Toit and eighteen natives were imprisoned, and here the rescue work was much more difficult. In the limited space available, however, gangs of twelve workers were kept going continuously, shift after shift, and up to date the relief parties had either rescued alive, or recovered the bodies of all except those of Du Toit and five natives.

A fine bronze statue of a kaffir miner working a jackhammer drill was recently presented to Sir Evelyn Wallers by the mine managers of the Central Mining-Rand mines group. The bronze was modeled by Anton van Wouw. A replica of the statue was recently presented to the Johannesburg art gallery by Felix Heim, who is a director of the Central Mining and Investment Corporation.

Recent shipments of gold specie from Durban for the Far East include £237,000 by the steamer "Karapara," which sailed on Nov. 21, and £80,000 by the "Kathiawar" on Nov. 19.

The great deep-water harbor of Takoradi, on the Gold Coast, which has been under construction for the past five years, will be opened to traffic next March by J. H. Thomas, under whose colonial secretaryship the scheme was sanctioned.

Earth tremors felt in Johannesburg to date during 1927 number 590, out of which 38 were classified at the Union observatory as very severe. According to H. E. Wood, assistant astronomer, these tremors are practically all caused by falls of rock in the mines.

The Grootvlei farm, on the Far East Rand, has an area of 2,500 claims. It is held by the Grootvlei Proprietary Mines, one of the Lewis and Marks companies. Over twenty years ago, Dr. Hatch estimated the ore content at 10,000 tons per claim. In this connection, Theodore Marks will soon make another business trip to London, and this is said to foreshadow early developments in this area.

Total imports into the Union of South Africa for the first half of 1927 amounted to £34,644,321, an increase of £152,436 over the corresponding period of 1926. Exports totaled £38,741,850, compared with £37,035,627 for the first half of 1926.

Melbourne Letter

By Peter G. Tait
Special Correspondent

Mining Operations May Be Resumed at the Golden Horseshoe Property

Melbourne, Nov. 30—J. W. Sutherland, general manager of the Golden Horseshoe gold mine, has sent a cable message to the directors of the company in London, stating that he has obtained government approval of his request for £500 to try an improved method for treating sulphide ore and refractory accumulated slimes. The minister for mines, Mr. Munsie, stated that the treatment of 20,000 tons of tailings at the Golden Horseshoe would be started at once. These tailings were expected to yield good results under the new process which has been brought about by the experience of Mr. Sutherland and C. R. Blackett, metallurgist of the mine. Under this process the tailings will not be roasted. Mr. Munsie mentioned that Mr. Sutherland expected that after he had opened the new plant for the treatment of tailings he would be in a position by the end of January to open up the mine generally and treat 3,000 tons of ore monthly.

The Federation tin mines, at Heemskirk, on the west coast of Tasmania, which were floated in London some little time ago, have completed the program of development. It is understood that the ore reserves are not up to the earlier expectations of 1,000,000 tons, averaging 1 per cent oxide. The old company purchased a battery at Beaconsfield. This plant was transported to the site, but it has been scrapped, and a plant equipped with a Marcy mill as a primary crushing unit and with concentrating tables is now being erected. It will have a capacity of 200 tons daily. The old company built a wooden tram line for transport between Zeehan and the mill, a distance of about 14 miles, but the new company decided that a road for motor transport would be of greater utility, and this is now completed. It is expected that treatment operations will start early in the new year.

THE fact that low prices for lead and zinc are seriously affecting the profits of the Broken Hill mines does not weigh with the unions. A new scale of wages and hours is being presented to the companies. It seeks a 30-hour week for men employed underground, a 35-hour week for men employed on the surface, a five-day week and a minimum wage of £7 per week. The union also asks for the abolition of the contract system, under which miners on development earn 38s. 3d. and on stoping 34s. 10d. per shift of seven hours. These are the average rates earned in the Broken Hill South mine over a period of twelve months. Underground men at present work 35 hours per week. There is little hope of these demands being granted in the face of present conditions. The companies will fight for the retention of the contract system.

Regarding oil, Dr. W. G. Woolnough, commonwealth government adviser, stated on his return from Papua, the Australian part of New Guinea, that he found indications of the existence of oil, but so far there has been no discovery pointing to oil being present in commercial quantities. The Anglo-Persian Oil Company spent a large sum there a few years ago without obtaining sufficient encouragement. Several companies are at work and are hopeful of striking oil in commercial quantity. Prospecting is hampered owing to the undeveloped state of the island. Dr. Woolnough will visit New Guinea (the mandated territory) within a short time, according to recent reports.

On the mainland, Roma, in Queensland, continues to be the center of greatest attraction, and a number of the oil prospecting companies have taken up areas. Dr. Woolnough's comment is summed up in the words "extremely encouraging but not yet absolutely conclusive." Another geologist, Dr. H. I. Jenson, is reported to have stated that to his mind the oil recovered from the Roma bore at present was not the kind of oil that would be got from the field when the main pools were discovered. It would then be medium to heavy oil.

Ardsley Butte to Increase Scale of Operations

Ardsley Butte Mines Corporation is planning to enlarge its shaft on the Highland group, southwest of Butte, Mont., and to continue it from the 350 level to the 500-ft. point. When this is done, the company expects to have a production of at least 150 tons per day. At present the company is averaging around 100 tons per day, the ore being extracted from an orebody 17 ft. wide situated on the 350 level. The peak production was reached on Dec. 7 when 158 tons was mined and delivered to the Washoe sampler of the Anaconda Copper Mining Company.

Tri-State Mill Equipped With Steam Radiators

One of the very few metal mine concentrators in the country to be equipped with steam radiators for heating purposes is located near Baxter Springs, Kan., in the Joplin-Miami field. It is the Empire mining plant, owned by F. W. Evans, of Picher, Okla.

Some years ago, Mr. Evans purchased an old college building at Webb City, Mo. He recently removed the radiators from the building and moved them to the Empire mill, where he installed them and also a steam boiler to furnish steam for the new heating system.

London Letter

By W. A. Doman
Special Correspondent

Tin Controversy Continues With Very Little Actual Progress Noticeable

London, Dec. 20—The tin controversy continues, and propaganda on both sides is in progress. Those who desire to stabilize the price at £300 or £325 and to restrict output, seem to be having the worst of the argument at the moment, for the price is only about £265, and the opponents of stabilization assert that it is better to proceed on the old lines, as substantial profits can be earned with the metal at between £260 and £275. It is suggested that advocates of restriction control properties with relatively short lives—say five to ten years. A large number of tin companies' meetings have been held within the last few days, so that shareholders and the public, if interested, have all the points laid before them. Whatever is going to happen seems to make no difference to dividends, for high distributions are being announced. The point that is put forward by opponents of stabilization is that the labor market would be disturbed, and, once this happens, difficulties would arise, even as far off as Bolivia. As no progress apparently can be reported, the matter is likely to remain where it is for the present.

ACCORDING to reports from Paris, an important deposit of cobalt has been discovered at Plombières, on the Arpens plateau. Some of the workmen were boring to find fresh water when they came across a curious dark substance which chemical analysis showed was 20 per cent cobalt, a metal very rare in France.

The general manager of the Wiluna Gold Corporation, Ltd., under the date of Oct. 7, 1927, estimates the ore reserves on the main east lode and west lode at 901,500 tons, of an average value of 39s. 2d. per ton. Since this estimate, the new east lode has been disclosed by drives and boreholes for an approximate length of 400 ft., averaging £2, 9s. 6d. over an average width of 5 ft. As the state mining engineer of Western Australia confirms these estimates, a government survey of the best route to Wiluna is to be undertaken, and a bill authorizing the construction of a railway has been passed at a recent session of the Parliament of Western Australia.

It is understood that the New Consolidated Gold Fields and their associates have decided to abandon their working option over the manganese properties of the Union Manganese Mines & Minerals (S.A.), Ltd., in the Postmasburg district of the Transvaal. The reason given is the difficulty of obtaining a footing in the European markets for the sale of manganese ore.

Recent Technical Publications

ORE DEPOSITION—The November *Bulletin* of the Institution of Mining and Metallurgy contains a report of the discussion of the paper entitled "Operative Causes in Ore Deposition," by H. C. Boydell, which was published in the October *Bulletin*. The original paper contains 85 pages.

NICKEL, COBALT—The paper by J. W. Gregory, entitled "The Nickel-Cobalt Ore of Talnotry, Kirkcudbrightshire," which also appeared in the October *Bulletin* of the Institution, is discussed by members in the November *Bulletin*.

IRON ORE—"The Brown Iron Ores of West-Middle Tennessee," by Ernest F. Burchard, has been published in Bulletin 795D of the U. S. Geological Survey. In the 60 pages of this bulletin, Mr. Burchard discusses the geology and distribution of the brown iron ores and describes typical deposits in various districts. He concludes with an estimate of the reserves, his figure being 8,900,000 tons.

QUICKSILVER—Bulletin No. 795E of the U. S. Geological Survey is entitled "Quicksilver Deposits of the Pilot Mountain, Mineral County, Nevada," by William F. Foshag. Mr. Foshag discusses the geology of the Pilot Mountains and gives a short study of the mercury deposits. The great hope for the future of the district, he says, lies in the possibilities of large bodies of low-grade ore suitable for furnace treatment. Cinnabar occurs widely in this area. The bulletin contains eleven pages.

ONTARIO MINING—The 36th Annual Report of the Ontario Department of Mines has just been received. It is divided into four sections, the whole comprising 104 pages. In the first two sections, the geology of the Michipicoten and the Goudreau-Lochalsh gold areas, in the Algoma district, is described. The third section is devoted to the Shiningtree silver area, in the Timiskaming district. The last section is devoted to the Wasapika section in the West Shiningtree area of the Sudbury District. In all of these sections the subject matter is presented in the excellent manner characteristic of the bulletins issued by the department.

GROUND SUPPORT.—The value of a support which will give steadily or under stress without collapse is well recognized. It became necessary to modify the system of mining in the eastern section of the Crown Mines, on the Rand, and, stulling behind ordinary props being considered insufficiently permanent and too costly, the idea of a compressible stull support was conceived. The practice as developed is described in a paper entitled "Telescopic Mine Props" by H. W. Adler, which appears in the September issue of the *Journal* of the Chemical, Metallurgical and Mining Societies of South Africa. The paper with its discussion covers five pages.

GEOLOGICAL MAPPING — The State Geologist of Kentucky has announced publicly the completion of one of the most comprehensive and detailed pieces of scientific research ever undertaken by a state survey. This is in connection with the releasing of oil and gas maps for every one of the thirty counties in the eastern Kentucky coal fields. The area covered by these maps is fully 10,500 square miles.

IRON MINING—Another bulletin by Dr. W. R. Crane, of the U. S. Bureau of Mines, has made its appearance. It is Technical Paper 407, entitled "Developments, Mining and Handling of Ore in Folded and Faulted Areas, Red Iron Ore Mines, Birmingham District, Alabama." Dr. Crane discusses present practice and trends and makes special suggestions as to changes.

IRON-ORE BENEFICIATION—The long-awaited bulletin of the Bureau of Mines on the beneficiation of iron ores in the Birmingham district recently made its appearance. It is Bulletin 278 and is entitled "Magnetic Concentration of Iron Ores in Alabama." The authors are Oscar Lee, B. W. Gandrud, and F. D. DeVang. It is sold at 20c. This bulletin may be considered in four parts, the topics being, respectively, magnetic concentration of high silica red ores; magnetic concentration of high-silica gray hematite of Talladega County, Alabama; flotation of limestone from siliceous gangue; and magnetic concentration of flue dust.

GILBERT, NEV.—Bulletin 795 F of the U. S. Geological Survey is entitled "Gilbert, Nev.," by Henry G. Ferguson. Its twenty pages contain a descriptive study of geology and ore deposits of this section of Esmeralda County, Nev. In conclusion, the author says that ore of sufficient promise to warrant further development has been found here and there. "If such development work is honestly and intelligently done," he says, "it should be clear within a short time whether the roseate expectations of the local miners are justified."

MINERAL RESOURCES—Recently issued chapters of "Mineral Resources of the United States, 1926" include: "Potash," pp. 6, by A. T. Coons; "Slate," pp. 8, by A. T. Coons; "Arsenic," pp. 4, by V. C. Heikes; "Mercury," pp. 15, by J. W. Furness; and "Gold, Silver, Copper, Lead, and Zinc in the Eastern States," pp. 5, by J. P. Dunlop. Each is obtainable for 5c. from the Superintendent of Documents, Washington, D. C.

FLOTATION AT BRITANNIA — H. A. Pearse has a paper in the November *Canadian Mining and Metallurgical Bulletin* on "The Concentration of Britannia Ores." The ore consists of a mixture of chalcopyrite and pyrite, with some soluble salts; each of these minerals is recovered in a concentrate. (Price of the *Bulletin*, $1 per copy; Canadian Institute of Mining and Metallurgy, Montreal.)

CABLE REELS—The October issue of *Electrical Mining* contains a seven-page article on the care and maintenance of electrical cable reels for "gathering" locomotives.

COPPER LEACHING — *The Chemical Engineering and Mining Review*, of Australia, in its Oct. 5, 1927, issue, contains a short article describing the copper leaching plant at Cloncurry, Queensland.

NEW ZEALAND—The annual report of the New Zealand Geological Survey has made its appearance.

PATENTS

FILTERING. No. 1,649,581. Nov. 15, 1927. Albert L. Genter and Jasper A. McCaskell, Salt Lake City, Utah, assignors to United Filters Corporation, New York.

A method and means for removing filter cakes from filter mediums.

KILN. No. 1,649,609. Nov. 15, 1927. George McCrae, Brantford, Ontario, Canada, assignor to Fuller Lehigh Company.

Details of design of a cylindrical kiln having a self-supporting metal shell and a refractory lining.

ROCK DRILL. No. 1,649,651. Nov. 15, 1927. Lewis C. Bayles, Easton, Pa., assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design of a chuck for rock drills.

FLOTATION. No. 1,649,685. Nov. 15, 1927. Albert W. Hahn and Charles M. Nokes, Salt Lake City, Utah.

A method of effecting preferential flotation of sulphide minerals from pyrite by subjecting a pulp of such minerals and containing small amounts of aluminum sulphate and a cyanide of an alkali metal to a froth flotation operation.

ROCK DRILL. No. 1,649,730. Nov. 15, 1927. William Prellwitz, Easton, Pa., assignor to Ingersoll-Rand Company, Jersey City, N. J.

A spring handle adapted to be substituted for the shell of a rock drill.

PLATINUM RECOVERY. No. 1,649,786. Nov. 15, 1927. Duncan C. Smith, Rockaway, N. J.

A process of recovering platinum from a heterogeneous mass which includes dissolving the mass in water, adding ingredients which will react to evolve hydrogen and form a salt, removing the platinum thrown down by the reaction and purifying it.

SCREEN—No. 1,649,883. Nov. 22, 1927. H. S. Woodward, Carbondale, Pa.

A vibrating screen, the vibration being secured by imparting a series of impulses to a roll carried on a member projecting at right angles from the underside and upper end of the screen frame.

Personal Notes

J. J. BEESON, Salt Lake consulting geologist, has returned from a mine examination near Bogota, Colombia, South America.

J. O. ELTON, manager of the International Smelting Company, has returned to Salt Lake City from a business trip to New York.

GILBERT LABINE, manager of the Eldorado mines, at Long Lake, Manitoba, is visiting Toronto to attend the annual meeting of the board of directors of the company.

BRENT N. RICKARD, manager at East Helena, Mont., plant of the American Smelting & Refining Company, spent the holidays in San Francisco with his family.

L. S. CATES, vice-president and general manager of the Utah Copper Company, and Mrs. Cates spent the holidays in San Francisco.

JOHN E. PENBERTHY, mining engineer and geologist, arrived in New York

JOHN E. PENBERTHY

on Dec. 24 from Douglas, Ariz., and sailed on Dec. 28 for Havre, France, on the "Rochambeau." After several years' service with the Phelps Dodge Corporation, Mr. Penberthy has joined the staff of the Union Minière du Haut-Katanga, his headquarters being at Elisabethville, in the Belgian Congo.

LEO HENNEBACH, ore purchaser for the American Smelting & Refining Company, has been transferred temporarily from Salt Lake City to Selby, Calif., headquarters.

W. H. EARDLEY, assistant manager of the United States Smelting, Refining & Mining Company, is back at Salt Lake City headquarters after a business trip to New York.

ROY STEVENS, former research chemist at the Midvale smelter of the United States Smelting, Refining & Mining Company, is manager of the Anglo American Corporation.

A. G. MACKENZIE, secretary of the Utah chapter of the American Mining Congress, is back in Salt Lake City after attending American Mining Congress meetings in Washington, D. C.

JAMES DOUGLAS has been awarded the honor of appointment as Chevalier of the Legion of Honor and he has received other honors from the French government in recognition of his sustained and noteworthy loyalty for the cause of France.

E. T. CORKILL has been placed in charge of operations by the Ramore Gold Mines, Ltd., which has just been organized to take over a group of eight claims in the Barnet Township section of the Larder Lake area of northern Ontario.

SHERWIN F. KELLY, assistant manager of the Schlumberger Methods and well-known writer on electrical prospecting, after making a tour of Western United States mining centers has returned to his home in Toronto to spend the holidays.

G. P. SCHUBERT has resigned as head of the civil engineering department of the Michigan College of Mining and Technology and accepted the position as superintendent of the Michigan smelter at Houghton, where he succeeds F. I. CAIRNS, resigned.

J. B. GORDON, of The Pas, who secured the option on the Sherritt Gordon mines, at Cold Lake, Manitoba has taken an option on a lead-zinc property at Mystery Lake, in northern Manitoba, and is visiting eastern Canada with a view of interesting capitalists in the enterprise.

A. B. YOUNG, assistant manager of the International Smelting Company, has left Salt Lake for South America on three months' leave of absence, during which he will make a study of the smoke problem at Cerro De Pasco. Mr. Young was accompanied by his wife and two daughters.

WILLIAM HENRY HARRISON, formerly senior mining engineer of the U. S. Bureau of Mines, and later senior valuation and appraisal engineer of the U. S. Bureau of Internal Revenue, has resigned his connections with the Treasury Department and returned to private practice with offices in the National Press Building, Washington, D. C.

DOUGLAS W. JESSUP, assistant superintendent of the Midvale, Utah, plant of the United States Smelting, Refining & Mining Company, has resigned to become assistant manager of the Anglo-American Corporation's electrolytic zinc plant at Broken Hill, North Rhodesia, Africa. Mr. Jessup will sail from New York, accompanied by Mrs. Jessup and his two boys, for London and Cape Town in January.

DR. THOMAS CROWDER CHAMBERLIN, professor emeritus of geology at the University of Chicago, was on Dec. 30 awarded the Penrose Medal for distinguished services in geology by the Geological Society of America, meeting in Cleveland, Ohio, last week. The Penrose Medal is the highest honor within the gift of the society. Dr. Chamberlin is the originator of the planitesimal theory with respect to the origin of the earth and the other planets comprising the solar system. He is eighty-four years old.

JEROME ALEXANDER, consulting chemist and chemical engineer, has been re-

JEROME ALEXANDER

tained in his professional capacity by the Vanadium Corporation of America.

OBITUARY

A. L. SMITH, the last of those who worked on the construction of the old Tombstone water supply, in the days when that camp was "wild and wooly," died recently in the Pioneers' Home in Prescott, Ariz.

HARRY WILLIAMS, formerly controller of the Bennett-Martin Asbestos Mines of the Thetford Mines, Quebec, died at Montreal on Dec. 22 at the age of 63 years. He was a native of Cornwall, England, and went to Montreal in 1909. He was for some years in the employ of the Canadian Vickers previous to his connection with the asbestos mining industry.

FRED SANDTNER, for the last ten years general mine foreman of the Calumet & Arizona Mining Company, died recently in Los Angeles. As underground foreman, Mr. Sandtner contributed a great deal in developing the present fill stoping systems at the Calumet & Arizona. For example, he was one of the first to use incline cut and fill stoping in the Southwest, and introduced it in places where formerly the former expensive square-set method was used. In general, he showed great ingenuity in the adaptation of mining methods to various types of orebodies. Mr. Sandtner leaves a widow and small daughter.

Market and Financial News

Non-Ferrous Metal Consumption Declines

DOMESTIC consumption of each of the major non-ferrous metals in 1927 was substantially less than in the preceding year, as is indicated in the accompanying table prepared by the American Bureau of Metal Statistics. The Bureau remarks that when diagrammed the three graphs for copper, lead, and zinc are substantially parallel, indicating that the same causes were affecting them in common. It appears also that while the total deliveries were in each instance materially less than in 1926, they were a little more than in 1925. The ratios are about the same for copper, lead and zinc. The data by months appear in the compilations in the accompanying tables.

Domestic Deliveries of Copper, Lead, and Zinc

	Copper		Lead		Zinc	
	Monthly	Daily	Monthly	Daily	Monthly	Daily
1925 (Averages)	69,264	2,277	57,320	1,885	44,808	1,473
1926 (Averages)	75,181	2,472	62,956	2,070	48,650	1,599
1927						
January	76,499	2,468	62,596	2,019	45,975	1,483
February	67,564	2,413	56,295	1,165	43,555	1,556
March	79,537	2,566	66,980	2,161	48,107	1,552
April	73,976	2,466	56,558	1,885	44,821	1,494
May	69,779	2,251	49,299	1,590	45,560	1,470
June	63,465	2,116	56,529	1,884	43,122	1,437
July	61,965	1,999	56,034	1,808	47,359	1,528
August	71,736	2,314	59,721	1,926	49,739	1,604
September	71,578	2,386	58,441	1,948	44,038	1,468
October	68,619	2,214	59,206	1,910	46,602	1,503
November	59,264	1,975	59,488	1,983	44,374	1,479
Totals	763,982	2,287	641,147	1,920	503,252	1,507

STATISTICAL NOTES

GRANBY CONSOLIDATED MINING & SMELTING COMPANY stockholders, at a recent meeting, ratified the action of the directors last May with regard to the creation of a reserve fund for depletion and depreciation. They also ratified the distribution of $432,262 made from that fund last July, and authorized further distributions not to exceed $1,778,408, equal to $4 a share.

CONSOLIDATED MINING & SMELTING COMPANY OF CANADA, in declaring a dividend of 5 per cent, or $1.25, plus a bonus of $5, payable Jan. 16, 1928, duplicates the two semi-annual payments made last year. The president of the company has announced that, in spite of lower metal prices, the profits for 1927 will not be less than in 1926. A larger scale of operations and improved operating technique are no doubt responsible.

ST. JOSEPH LEAD COMPANY, in announcing quarterly dividends of 75c. per share throughout 1928, estimated net income for 1927, before providing for depreciation, depletion, and federal income taxes, at $7,900,000. Allowing $900,000 for depreciation, $2,700,000 for depletion, and $700,000 for taxes, leaves an estimated net income of $3,600,000. Dividends for the year totaled $5,851,305.

Imports and Exports of Ores and Metals in November, 1926 and 1927

Compiled from U. S. Department of Commerce Records

In Pounds Unless Otherwise Stated

Imports

	November 1926	November 1927
Antimony		
Ore { Gross weight	377,316	828,263
Ore { Antimony content	187,414	436,920
Liquated regulus or metal	2,151,721	1,645,118
Copper		
Ores, copper content	3,137,105	9,084,540
Concentrates, copper content	4,140,506	3,346,919
Regulus, coarse metal, cement copper	60,664	124,574
Imported from:		
Spain	873,008	573,327
Canada	3,464,897	5,065,467
Mexico	445,100	1,828,816
Cuba	2,086,078	1,241,933
Chile	208,856	3,037,922
Peru	118,734	84,587
Other countries	141,602	723,981
Unrefined, black, blister, converter copper in pigs, bars, and other forms	31,339,350	25,381,230
Refined copper	10,548,007	9,113,627
Old and clippings for remanufacture	1,057,708	672,980
Composition metal, copper chief value	.....	11,196
Brass		
Old and clippings for remanufacture	686,300	532,094
Lead		
Ore and matte, lead content	10,061,122	6,615,766
Bullion or base bullion	9,156,870	21,829,837
Pigs and bars	4,213,708	215
Babbitt, solder and other forms, lead content	528,624	117,980
Type metal, antimonial lead { Gross weight	222,645	.....
Type metal, antimonial lead { Lead content	173,987	.....
Manganese		
Ore, tons		
Cuba, manganese content	.....	63
Other countries, manganese content	17,096	26,739
Pyrites, tons	27,545	32,516
Tin		
Ore, tons	8	10
Bars, blocks, pigs	15,415,353	10,923,902
Imported from		
Netherlands	1,542,190	515,780
United Kingdom	5,307,847	1,882,204
British Malaya	7,841,403	8,123,551
Dutch East Indies	58,464	.....
Hongkong	112,077	11,179
Australia	340,480	123,200
Other countries	212,892	267,988
Zinc		
Ore, zinc content { Free	.....	.....
Ore, zinc content { Dutiable	5,807,761	183,200
Blocks, pigs and old	785	315

Exports

	November 1926	November 1927
Copper		
Ores, composition, concentrates, unrefined	154,331	549,292
Refined copper in ingots and other forms	83,387,113	70,420,876
Exported to		
Belgium	7,839,321	9,706,118
France	11,507,115	11,101,775
Germany	19,953,614	14,409,880
Italy	4,856,583	7,375,591
Netherlands	9,799,419	8,222,802
Spain	1,837,774	369,861
Sweden	2,153,898	1,764,498
United Kingdom	19,130,352	11,269,243
Other Europe	342,086	4,854,916
Canada	955,394	399,244
British India	168,000	414,550
China, Hongkong, Kwantung	505	89,600
Japan	4,422,815	335,906
Other countries	420,237	106,892
Old and scrap	3,689,431	4,594,462
Pipes and tubes	263,212	135,896
Plates and sheets	187,916	361,142
Rods	4,496,410	5,472,246
Wire	918,282	1,273,116
Insulated copper wire and cable	1,289,222	2,149,537
Lead		
In pigs, bars, and other forms	13,214,776	16,935,313
From domestic ore	182,882	304,387
From foreign ore	13,031,894	16,630,926
Exported to		
Belgium	112,045	56,043
France	806,726	2,856,506
Germany	5,377,499	2,184,424
Netherlands	515,324	1,814,872
Sweden	.....	392,204
United Kingdom	5,265,505	5,938,095
Other Europe	.....	504,033
Brazil	337,116	224,048
Other South America	82,722	459,360
China, Hongkong, Kwantung	112,015	336,482
Japan	560,164	2,072,841
Other countries	45,660	96,405
Other lead manufactures	1,007,916	576,271
Zinc		
Ores and concentrates, tons	5,543	.....
Dross	1,678,772	1,052,613
Cast in slabs, blocks and pigs	6,482,833	4,030,088
Exported to		
Belgium	.....	225,735
France	560,046	21,512
Germany	44,800	411,870
Italy	112,025	.....
Netherlands	263,431	305,561
United Kingdom	1,411,854	283,650
Other Europe	1,232,473	.....
Argentina	941,184	.....
British India	.....	.....
Japan	1,624,074	2,571,119
Other countries	292,944	210,641
Sheets, strips, other forms	614,327	747,913
Dust	87,231	160,668
Other zinc manufactures	137,941	221,769

The Market Report

Copper Prices Stiffen Despite Inactive Market—Lead and Zinc Steady

New York, Jan. 4, 1928—Markets for the non-ferrous metals have been very quiet during the week ending today. Copper, however, has shown quotational strength and is virtually established at 14.125c. delivered. Lead is unchanged in New York and slightly firmer in St. Louis; whereas zinc is, if anything, a shade weaker. Tin prices are off a fraction of a cent in the domestic market, and silver is a trifle easier, with no perceptible trend. An interesting development is the stiffening of the platinum market to close to $70. It is understood that the Russian interests that were responsible for the precipitous decline about six months ago have increased their price, and other sellers have followed suit. No marked change in the volume of buying by jewelers is reported, that might account for the improvement in the price. Iridium has taken a sensational jump, and little is to be had at $280 per ounce. The International Nickel Company has reduced the price on electrolytic nickel by 2c. per pound.

Although the week has been dull so far as purchases are concerned, sentiment among sellers of the metals is excellent, with the possible exception of zinc. The many diagnoses of the general industrial situation for the first half of 1928 that are published by economists and bankers at this season of the year seem unanimously favorable, and this has strengthened the confidence of producers that demand will be good.

Daily Prices of Metals

Dec. Jan.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	13.775@13.80	57.625	57.75	6.50	6.30	5 65
30	13.775@13.80	57.75	57.875	6.50	6.30	5.625@5.65
31	13.775@13.80	57.75	57.875	6.50	6.30	5.625@5.675
2	Holiday	.....	.....	....	....	.....
3	13.825@13.90	57.50	57.75	6.50	6.30@6.325	5.625@5.65
4	13.85@13.925	56.75	57.375	6.50	6.30@6.325	5.625
	13.823	57.475	57.725	6.500	6.305	5.640

Average prices for calendar week ending Dec. 31, 1927, are: Copper, 13.788; 99 per cent tin, 57.725; Straits, 57.875; N. Y. lead, 6.500; St. Louis lead, 6.300; zinc, 5.648; and silver, 57.575.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.13c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Dec. Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	60 7/8	61	66 1/2	265	261 1/2	22 3/8	22 11/16	26 3/8	26 1/8
30	60 3/4	60 13/16	66 1/2	265 1/4	261 1/4	22 13/16	22 13/16	26 1/2	26
2	61 1/16	61	66 1/2	265 1/2	262 1/4	22 7/16	22 11/16	26 7/16	26
3	61 9/16	61 1/2	66 1/2	263 1/2	261 1/4	22 5/16	22 3/8	26 1/8	26 1/8
4	61 3/4	61 3/4	66 1/2	258 3/4	258 1/2	22 5/16	22 5/16	26 5/16	26 1/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4.87 3/8	57 3/4	26 9/16	84s11 1/2d	2	Holiday	...	26 7/16	84s11d
30	4.87 3/8	57 1/2	26 3/8	84s11d	3	4.87 3/8	57 3/8	26 3/8	84s10 1/2d
31	4.87 3/8	57 1/2	26 1/2	.....	4	4.87 3/8	57 1/2	26 7/16	84s11d
					Avg.		57.575		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half of a cent premium.

Average Metal Prices for December, 1927

COPPER:	
New York Electrolytic	13.774
London Standard Spot	60.078
London Electrolytic Spot	66.181
LEAD:	
New York	6.504
St. Louis	6.319
London Spot	22.163
London Forward	22.441
SILVER:	
New York	57.957
London	26.701
Sterling Exchange	487.714
ZINC:	
St. Louis	5.722
London Spot	26.363
London Forward	26.109
TIN:	
99 per cent	58.053
Straits	58.452
London	267.138
QUICKSILVER	126.933
ANTIMONY	11.195
PLATINUM:	
Refined	72.000
CRUDE	62.000
ALUMINUM, 98 PER CENT	24.785

Copper at 14.125c.

During the week copper has sold at prices ranging from 14c. to 14.125c. Connecticut Valley basis, though but one small sale at 14c. has been made since Dec. 31. Since then the bulk of the metal has brought 14.125c., though the split price was obtained by some fortunate buyers. A big tonnage brought 14.25c. for delivery in the Middle West today. Large producers have held consistently at 14.125c., Valley, for several weeks. The strength of the foreign market yesterday and today has been a bullish feature. Copper Exporters, Inc., have maintained their price at 14.50c. c.i.f., at which level excellent sales have been made. The f.a.s. market, likewise, has been good at 14.25c. In the view of some, speculative buying abroad is a contributing

factor; on the other hand, so far as Germany, the principal buyer, is concerned, the great bulk of the metal is for near-by delivery and goes into current consumption.

Lead Prices Hold Steady

Though the lead market has not been active, a very fair tonnage has been sold by those who have gone out actively for business. The New York price continues unchanged at 6½c., the contract price of the American Smelting & Refining Company, which has been maintained since Dec. 1. No one seems disposed to quote either more or less than this figure, regardless of time of shipment. In the Middle West, there is a slight disposition to quote higher prices than 6.30c., St. Louis, as one seller is not anxious to dispose of any more January lead, and has been unwilling to sell for less than 6.325 or 6.35c. Other sellers were also able to secure 6.325c. yesterday, and 6.325c. has been secured today for forward lead, though some offers of prompt metal were made on both days at 6.30c., at which price a good supply seems to be available.

Producers are well satisfied with the present condition of the lead market in spite of the fact that the price is 1¼c. less than it was a year ago at this time. Consumption promises to be better than it was in the first quarter of 1927, judged by specifications on contracts, with all three of the principal outlets—cables, batteries, and paint—showing up well.

Zinc Marks Time

Though not up to normal, business in the zinc market has not been entirely absent. Prices have ranged from 5.625c. to 5.675c., the higher figure covering metal for forward delivery. The foreign market has been better than the domestic, and prices abroad are above domestic parity. It seems highly probable that any further recession, say to 5.50c. for domestic zinc, would result in substantial curtailment in production. Likewise, buying would be stimulated and an upward reaction in the price would be the consequence. In other words, it seems that the price is unlikely to undergo further material decline.

Tin Brightens Up Today

Little interest has existed in the tin market until today, when the lower prices caused several orders to be placed by both speculators and consumers. Forward tin has ruled about one-eighth cent less than prompt. Prices on the 99 per cent grade have recently been only nominal, as only a very little has been imported into the country and that little goes directly to consumers.

Silver 57½c.

During the last week the tone of the silver market has continued steady. Buying for China account is the chief factor at the moment, as India shows little interest at prevailing rates.

Mexican Dollars (old Mexican pesos)—Dec. 29th, 44⅜c.; 30th and 31st, 44⅛; Jan. 2d, holiday; 3d, 44¼c.; 4th, 44⅜c.

Foreign Exchanges Steady

The principal foreign exchanges are substantially unchanged from last week. Closing cable quotations on Tuesday, Jan. 3, were as follows: francs, 3.93⅝c.; lire, 5.28¼c.; and marks, 23.86¼c. Canadian dollars were at ¼ per cent discount, approaching the gold point, as was expected at this season.

Ore Prices Unchanged in Joplin

Joplin, Mo., Dec. 31, 1927

Blende	Per Ton
High	$41.00
Premium blende, basis 60 per cent zinc	$36.00@ 37.00
Prime Western, basis 60 per cent zinc	35.00
Fines and slimes, 60 per cent zinc	$31.00@ 34.00
Average settling price, all zinc	36.76
Galena	
High	$85.80
Basis 80 per cent lead	85.00
Average settling price, all lead	83.60

Shipments for the week: Blende, 9,676; lead, 3,486 tons. Value, all ores the week, $647,110. Shipments for the year: Blende, 668,201; lead, 104,866 tons. Value, all ores the year, $36,549,460.

Production of zinc concentrates for this week was 6,360 tons, approximately 45 per cent less than the recent average, owing to holiday curtailments. Reserves of lead ore held in Oklahoma were loaded this week to escape tax assessment, reducing lead ore stocks to but 10,000 tons.

Platteville, Wis., Dec. 31, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$37.75
Lead Ore	
Lead, basis 80 per cent Lead	$85.00

Shipments for the week: Blende, 1,193 tons; lead, 40 tons. Shipments for the year: Blende, 64,497; lead, 2,085 tons. Shipments for the week to separating plants, 1,795 tons blende.

Steel Production Likely to Increase

Pittsburgh, Jan. 3, 1928.

Steel ingot production in 1927 was approximately 43,400,000 long tons, representing a 7½ per cent decrease from 1926, the record year, and approximately matching the 43,485,665 long tons produced in 1923, four years earlier. The deficit was almost entirely in the second half of the year. It seems probable that 1928 will make a new high record by a small margin, not engaging full capacity, as 1927 production represented only 75 per cent of reported capacity.

Steel prices declined slightly during 1927 but towards the close of the year producers were filled with a greater spirit of co-operation. The year closed with a slight advance in bars, shapes and plates and with higher prices quoted on sheets and wire nails, the advanced prices not having applied as yet to any volume of sales.

In line with all recent precedents, steel production will now increase, the increase being probably longer and more gradual than in the past four years, when March was the high month of each year.

Pig Iron—There has been a fair turnover in foundry iron. Prices are steady: Bessemer, $17.50; basic, $17; foundry, $17.25@$17.50.

Connellsville Coke—Spot coke: Heating, $2.50@$2.65; furnace, $2.75; foundry, $4@$4.75.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 and 98 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c. London, 98 per cent, quoted at £104@£107 per long ton for domestic consumption.

ANTIMONY—Per lb., duty paid, spot: Chinese brands, 10¼@10⅜c. Market quiet. Cookson's "C" grade, spot, 16⅜c.

Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c. Nominal.

BISMUTH—Per lb., in ton lots, $1.85@$2.10. London, 8s. Domestic market continues below London parity.

CADMIUM—Per lb., 60c. London, 1s. 11d. for Australian metal.

COBALT—Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 10s. for metal; 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gram in 300- to 500-gram lots, $5.

IRIDIUM—Per oz., $260@$280 for 98@99 per cent sponge and powder. Little metal available and price soaring on sharp demand.

LITHIUM—Per oz., 98@99 per cent grade in 1- to 5-lb. lots, $1.55.

MAGNESIUM—Per lb., in ton lots: 8-lb. ingots (3x3x16 in.), 98c.; 3-lb. sticks (1⅛x33 in.), $0.95@$1; 10-oz. sticks (1x12 in.), 85@90c. Market quiet. London 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per gram, 99 per cent, 2½c.; chemically pure metal, 8c. (Usually sold as calcium molybdate or ferromolybdenum, which see).

MONEL METAL—Per lb. base price for shot, 28c., f.o.b. Huntington, W. Va.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.90 per cent grade), for single lots of spot metal. Good demand. London, per long ton, £170@£175 according to quantity. Business fair.

OSMIUM—Per oz., $60@$65; London, £11@£13.

PALLADIUM—Per oz., $49@$51. Small lots bring up to $55. London £10¼@£11. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Dealers and refiners quote the trade for refined metal, per oz., $69@$70, cash. Market active; prices higher. Russian interests have increased quota-

[1]Price furnished by Foote Mineral Co., Philadelphia.

tions and others have advanced at the same time.

London, per oz., £13⅜@£14 for refined; crude and scrap, nominal.

QUICKSILVER — Per 76-lb. flask, $125.50@$127. Market quiet. San Francisco wires $129.50. London firm at £23.

RADIUM — Per mg. radium content. $70.

RHODIUM—Per oz., $50@$55; London, £8@£11½. Nominal.

RUTHENIUM — Per oz., $50@$55. Nominal. London, £6@£8½.

[1]SELENIUM—Per lb. in ton lots; Black, powdered, amorphous, 99.5 per cent pure, $1.90@$2. London, 7s. 8d. @7s. 9d.

TANTALUM — Per gram: Bar and heavy sheet, chemically pure, 20c. Firm.

TELLURIUM—Per oz., 12½c.

[1]THALLIUM METAL—Per oz.: Ingot, 99 per cent pure, 95c. in 25-lb. lots.

TUNGSTEN POWDER — Per lb. contained tungsten, 97 to 98 per cent pure, $0.95@$0.98.

[1]ZIRCONIUM METAL—Per oz., 98 per cent grade, 95c. in 5- to 10-lb. lots.

Metallic Ores

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, $22.50@$23 for 45 to 50 per cent Cr_2O_3 ore. Prices firm.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 58 to 63 per cent, 8@8½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

North African, low-phosphorus, 11 @11½c., nominal.

Spanish foundry or basic, 50@54 per cent, 8½@9c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 35@38c. Caucasian (washed), 53@55 per cent, 38.50@40c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80. Domestic, 70 to 72 per cent, $40@$50.

TANTALUM ORE—Per unit of Ta_2O_5, basis 65 per cent ore, $13.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $9.50@$10.50, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 96 per cent concentrate, 11c. to 13c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.25@$10.50, Western scheelite, $10.50@$10.75. Market dull, prices largely nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest:

Crude No. 1, $650; crude No. 2, $400 @$500; spinning fibers, $200@$225; magnesia and compressed sheet fibers, $160@$175; shingle stock, $75@$125, various grades; paper stock, $45@$50; cement stock, $25; short fibers, $10@ $20; floats, $15. Market very active for all grades above paper stock. Prices on brake lining recently advanced 10 per cent by large interests.

Per ton c.i.f. New York: Rhodesian crude No. 1, $450; No. 2, $350.

BARYTES—Per long ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $7. Wet ground, off color, $12@$18, depending on analysis. Shipments steady; demand good.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, per ton, $7.50, f.o.b. mines. Market fair.

BAUXITE — Per long ton: No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3 $8, f.o.b. *Georgia* mines. Pulverized and dried $14; calcined $18@$20.

Per metric ton, foreign, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

BORAX—Per lb.: Carload lots, in bags, crystals, 4c.; granulated or powdered, 3¾c.; f.o.b. plant, Pennsylvania. Keen competition in market and prices weaker.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour No. 1, $20; No. 2, $17. Market fair.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $45@$50. English Clay Producers Association has announced an advance of $2 per ton on lower-priced grades for 1928.

[1]Price furnished by Foote Mineral Co., Philadelphia.

DIATOMITE — Per short ton, f.o.b. plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in. $20; air-floated powder, $45. Over 85 per cent silica, 98 per cent through 200 mesh, $25@$26, depending on quantity. Market fair to good.

EMERY — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6@$7.50. Demand good.

New Hampshire, per ton: Pottery grade, $8.50. Best quality lump, $9. Market good.

New York, Per ton: f.o.b. cars, No. 1 crude, $9. Market very quiet.

Tennessee, per ton: No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2. enamel, 140 mesh, $13.75; 200 mesh, $15.50; demand light but prices firm.

Maine, per ton: Best pottery grade, ground, $19. Market good.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines.

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $15.75@$16. Quiet. Foundry lump, 85-5, $18. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Demand extremely quiet and prices weak.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16.50; 90-4 lump, $19.50; 96-3 ground, 100 mesh, $32.50, bulk. Market good; orders placed for 1928 sufficient to assure sustained operation of mines.

Foreign spar, duty paid, $16@$16.25, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh up, $8; 200 mesh up, $14. Market fair at unchanged prices.

Powdered, import duty paid, $24@ $25 per ton.

GARNET — Per ton; domestic, f.o.b. mines, $85. Market easy.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE — Per ton: F.o.b. *New York.*

Ceylon lump, 8@8½c.; chip, 7@7½c.; dust, 3@5½c.; Madagascar flake, 7@7½c. Market fair.

No. 1 flake, 8c. and up. Foundry facings, 3c. and up. Amorphous and crystalline, fine ground, 3c. and up. Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25. More inquiries indicate better business.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$10; agricultural, $6@$15; calcined, $8@$10.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 2½@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 75c.@$2.

Agricultural, 75c. up to $4 or $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; grade B, $38; dead burned, $30@$32; crude, $14. F.o.b. Eastern seaboard, calcined, $40.

MICA—Per ton, f. o.b. plant:

New Hampshire: Mine run, $300; clean shop scrap, $25; mine scrap, $22. White dry ground, 20 mesh, $25; 40 mesh, $40; 60 mesh, $65; 100 mesh, $80; 200 mesh, $100. Market fairly active and somewhat firmer.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: No. A1, $3.50@$4; No. 1, $3; No. 2, $2.50; No. 3, $1.30; No. 4, 70@80c.; No. 5, 45c. Market strong.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $120.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18. Market fair.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm.

Florida, pebble, domestic: 76@77 per cent, $6; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50. Market fair.

Tennessee, ground, 97 per cent through 200 mesh, 33 per cent P_2O_5, $9.40 per ton. Brown lump for acid manufacture, per gross ton, $5.50 on 75 per cent basis; $4.50 on 72 per cent basis.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent....	36.40	34.80
Sulphate of potash 90 @ 95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent.....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: Tharsis, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 2½-in. diameter, 13½@13¾c. Same price for fines screened through ½-in. mesh. Cinder from ore to remain property of buyers. Good inquiry but few orders.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. For optical purposes, double above prices; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois; 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35 @$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per ton for domestic market, $18, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Good shipment against contracts. Open prices $1 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $9.50@$10.50; 99 per cent through 200 mesh, medium white, $8.50@$9.50; packed in 50-lb. paper bags. Most contracts for 1928 have been closed. Tonnage promises to be as large or a little larger than for 1927.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@ $10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $10 @$12; market fair.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Business seasonally quiet.

[1]ZIRCON—Per lb., f.o.b. mines in carload lots: 95 per cent, 3c.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb. 4c. Quiet. London, per long ton, £18¼ for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE — Per lb. of contained Mo, 95c., delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5.05@5.10c., for either large or small crystals.

[1]Price furnished by Foote Mineral Co., Philadelphia.

SODIUM NITRATE—Per 100 lb.; crude, in bags ex vessel, Atlantic ports, $2.40 @$2.45 for spot; future delivery, $2.40.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $17@$20.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Ferro-Alloys

[1]FERROCERIUM—Per lb., $5.50.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11c.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $100, for first quarter of 1928. Spiegeleisen, 19@21 per cent, $30 on carload business, f.o.b. furnace. Market dull.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River: 50 per cent, $83.50; 75 per cent, $135; 14@16 per cent, $45. Market fairly active.

FERROTITANIUM—Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, 93@95c., f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, $3.15@$3.50, depending on grade. Market good.

Metal Products

ROLLED COPPER—Sheets, 22¾c.; wire, 15¾@16c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled 10c. per lb.; clipped 10¼c.

NICKEL SILVER—29½c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods, 16¾c. per lb.

ZINC SHEETS—10c. per lb., f.o.b. works.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$45, *Ohio, Kentucky, Central Pennsylvania;* second quality $35 @$37.

MAGNESITE BRICK—Per net ton, f.o.b. works: 9-in. straights, $65.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $52.

[1]ZIRKITE—Per lb.: Powdered, 80 per cent ZrO_2, 3c. Brick, straights, 80c.@ $1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1926	1927	1926	1927	1926	1927
January	67.795	55.795	31.322	25.863	485.295	484.775
February	66.773	57.898	30.797	26.854	485.852	484.551
March	65.880	55.306	30.299	25.655	485.606	484.887
April	64.409	56.399	29.682	26.136	485.702	485.178
May	65.075	56.280	30.125	26.072	485.485	485.288
June	65.481	56.769	30.248	26.203	486.000	485.183
July	64.793	56.360	29.861	25.983	485.755	485.145
August	62.380	54.718	28.773	25.224	485.293	485.546
September	60.580	55.445	27.904	25.565	484.845	485.878
October	54.505	56.035	25.291	25.776	484.475	486.533
November	54.141	57.474	25.192	26.526	484.359	486.956
December	53.466	57.957	24.733	26.701	484.553	487.714
Year	62.107	56.370	28.686	26.047	485.268	485.636

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic		London Spot Standard		London Spot Electrolytic	
	1926	1927	1926	1927	1926	1927
January	13.822	12.990	59.013	55.414	65.325	62.375
February	13.999	12.682	59.669	54.438	66.375	61.119
March	13.859	13.079	58.603	55.935	65.489	62.641
April	13.706	12.808	57.200	55.056	64.600	61.526
May	13.599	12.621	56.494	54.563	64.313	60.881
June	13.656	12.370	56.778	54.030	64.591	59.881
July	13.924	12.532	57.864	54.551	65.625	60.089
August	14.174	12.971	58.857	55.364	66.857	62.227
September	14.062	12.940	58.705	54.455	66.528	61.830
October	13.862	12.958	58.304	55.119	66.298	62.256
November	13.576	13.319	57.293	58.830	65.551	63.761
December	13.302	13.774	56.869	60.078	64.114	66.181
Year	13.795	12.920	57.971	55.053	65.472	62.064

New York quotations, cents per pound. London, pounds sterling per long ton

Lead

	New York		St. Louis		London			
	1926	1927	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	9.255	7.577	9.102	7.392	34.778	34.584	27.485	27.786
February	9.154	7.420	8.991	7.286	33.903	33.903	27.344	27.781
March	8.386	7.577	8.165	7.328	31.625	31.921	27.845	28.302
April	7.971	7.126	7.764	6.807	28.775	29.284	26.546	27.053
May	7.751	6.616	7.538	6.269	28.253	28.719	25.054	25.526
June	8.033	6.414	7.876	6.150	29.986	30.142	24.438	24.750
July	8.499	6.344	8.383	6.120	31.716	31.545	23.491	23.932
August	8.908	6.681	8.722	6.367	32.756	32.345	23.119	23.540
September	8.786	6.297	8.515	6.044	32.085	31.790	21.446	21.994
October	8.402	6.250	8.130	6.013	30.821	30.696	20.479	20.946
November	8.005	6.259	7.800	6 035	29.270	29.563	20.889	21.318
December	7.855	6.504	7.688	6.319	28.932	29.264	22.163	22.441
Year	8.417	6.755	8.223	6.511	31.075	31.146	24.192	24.614

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	1926	1927	1926	1927	1926	1927
	99%		Straits		Spot	
January	61.415	64.785	62.275	66.415	282.038	297.804
February	62.653	66.528	63.705	69.142	287.107	306.125
March	63.472	67.833	64.505	69.199	292.288	313.315
April	61.962	66.069	63.389	67.933	281.388	302.572
May	60.165	63.935	62.305	67.510	270.125	294.938
June	58.409	64.226	60.611	67.466	268.352	296.006
July	61.365	62.625	63.091	64.110	282.102	288.690
August	63.875	63.523	65.260	64.431	293.690	293.193
September	66.535	60.735	68.895	61.490	306.273	280.432
October	68.225	57.560	70.245	58.450	312.548	264.631
November	68.667	57.089	70.630	57.641	309.284	262.591
December	66.635	58.053	68.514	58.452	306.994	267.138
Year	63.615	62.747	65.285	64.353	291.016	288.953

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	8.304	6.661	38.059	37.363	30.979	30.938
February	7.759	6.673	36.053	35.956	29.931	30.109
March	7.332	6.692	34.090	34.247	30.649	30.889
April	7.001	6.338	32.503	32.863	29.579	29.901
May	6.821	6.075	32.038	32.413	29.034	29.131
June	7.112	6.213	33.244	33.398	28.598	28.613
July	7.411	6.229	34.045	34.270	28.280	28.021
August	7.376	6.342	34.173	34.524	28.210	28.068
September	7.413	6.212	34.389	34.415	27.347	27.327
October	7.296	5.996	34.256	34.146	26.899	26.634
November	7.199	5.745	33.491	33.483	26.281	26.006
December	7.018	5.722	32.915	32.895	26.363	26.109
Year	7.337	6.242	34.105	34.164	28.513	28.479

St. Louis quotations, cents per pound. London, pounds sterling per long ton

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York	
	1926	1927	1926	1927	1926	1927	1926	1927
Jan.	23.490	13.910	87.960	101.200	118.200	109.520	113.200	99.820
Feb.	21.676	14.509	87.580	101.727	113.909	107.545	108.341	99.295
March	19.708	12.801	88.194	110.259	112.000	108.000	106.278	100.426
April	17.462	14.166	89.769	123.250	111.538	101.885	103.731	91.865
May	12.170	12.975	91.365	123.900	108.960	84.680	102.900	75.000
June	11.106	12.447	91.346	118.096	111.000	72.000	106.615	62.500
July	14.490	11.880	90.163	119.880	114.692	72.000	109.000	61.520
Aug.	15.957	11.826	89.260	119.111	116.000	72.000	108.692	62.000
Sept.	15.325	11.073	91.425	119.640	116.840	72.000	108.600	62.000
Oct.	13.943	11.165	97.260	126.200	112.240	72.000	106.000	62.000
Nov.	13.385	10.763	99.000	127.708	112.000	72.000	105.250	62.000
Dec.	13.142	11.195	99.510	126.933	111.846	72.000	105.385	62.000
Year	15.988	12.393	91.903	118.159	113.269	84.636	106.999	75.036

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75-lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh; and Aluminum, 98 Per Cent

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1926	1927	1926	1927	1926	1927	1926	1927
Jan.	22.76	21.04	21.76	20.01	22.26	20.26	27.000	26.270
Feb.	22.76	20.76	21.76	19.76	22.26	20.26	27.000	26.000
March	22.76	21.15	21.76	20.33	22.26	20.26	27.000	26.000
April	21.38	21.26	20.66	20.49	21.05	20.26	27.000	26.000
May	21.12	20.94	19.76	19.96	20.76	20.26	27.000	26.000
June	20.76	20.66	19.76	19.62	19.80	20.11	27.000	26.000
July	20.44	20.26	19.26	19.26	19.49	19.76	27.000	26.000
Aug.	19.87	20.07	19.18	19.01	19.26	19.40	27.000	26.000
Sept.	20.11	19.96	19.26	19.04	19.30	19.46	27.000	26.000
Oct.	20.76	19.76	19.76	18.76	19.97	19.26	27.000	25.600
Nov.	21.90	19.64	20.46	18.76	20.96	19.23	27.000	25.000
Dec.	21.26	.....	20.26	.....	20.53	.....	26.934	24.785
Year	21.31	.....	20.29	.....	20.64	.....	26.955	25.808

Iron in dollars per long ton. Aluminum in cents per lb., 98 per cent grade.

Monthly Crude Copper Output in Short Tons

Domestic

	1927 June	July	Aug.	Sept.	Oct.	Nov.
Alaska shipments	2,105	2,798	2,138	1,879	4,747	1,402
Butte & Superior	†453	.....	.....	†204	.....	.....
Calumet & Arizona	2,075	1,866	2,577	1,807	2,157	2,018
Magma	1,250	1,066	1,182	1,196	1,298	1,404
Miami	2,176	2,233	2,268	2,008	2,245	2,099
New Cornelia	2,895	2,496	3,039	3,137	3,718	3,613
Nevada Con	†27,821	.....	.....	†26,298	.....	.....
Old Dominion	815	825	850	931	871	332
Phelps Dodge††	8,085	7,706	7,366	7,779	7,770	7,799
United Verde Extension	1,768	1,868	1,905	1,813	1,933	1,698
Utah Copper	†30,028	.....	.....	†27,786	.....	.....
Tennessee Copper	390	408	445	412	532	594

Foreign

Andes Copper Mining Co.	2,495	2,370	2,367	2,367	2,367	.....
Braden	7,447	8,986	8,995	8,991	9,343	.....
Boleo, Mexico	1,115	1,215	1,067	852	990	990
Bwana M'Kubwa	464	337	366	336	496	447
Chile	8,988	9,005	9,020	8,934	8,954	.....
Furukawa, Japan	1,569	1,367	1,461	1,549	1,501	.....
Granby Cons., Canada	2,287	2,261	2,261	2,268	2,550	2,208
Mount Lyell, Aust	†1,423	.....	.....	†1,515	.....	.....
Sumitomo, Japan	.....	1,693	1,338	760	1,608	.....
Union Miniere, Africa	7,004	8,065	8,008	9,075	10,230	10,890

†Three months.
††Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1925 Monthly Production	1925 Daily Rate	1926 Monthly Production	1926 Daily Rate	1927 Monthly Production	1927 Daily Rate
January	74,789	2,412	71,026	2,291	76,198	2,458
February	68,967	2,463	68,131	2,433	69,202	2,472
March	74,901	2,416	75,728	2,443	69,314	2,236
April	70,667	2,356	73,454	2,448	71,122	2,371
May	70,574	2,275	73,542	2,372	71,613	2,310
June	59,894	2,330	71,317	2,377	69,539	2,318
July	68,507	2,210	72,278	2,330	65,545	2,114
August	68,090	2,196	72,014	2,323	67,248	2,169
September	67,720	2,272	72,672	2,421	65,936	2,198
October	71,042	2,292	75,099	2,423	68,595	2,225
November	67,400	2,247	74,947	2,498	67,813	2,260
December	69,566	2,244	72,205	2,329	.....	.....
Total	842,117	.....	872,509	.....	762,489	.....
Monthly average	70,176	.....	72,709	.....	69,317	.....
Average of daily rate	.....	2,307	.....	2,390	.....	2,283

Mining Stocks—Week Ended December 31, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	60	56⅜	58⅛	Ja.14, Fe.20 Q	0.75
Arcadian Consol.	Boston	3⅛	2⅞	3		
Ariz. Com'l	Boston	6⅛	5⅜	5⅞	Jy. 18, Jy. 30	0.25
Calaveras	N. Y. Curb	...	...	1⅛		
Calumet & Arizona	New York	119½	112½	117⅝	De. 3, De. 9 Q	1.50
Calumet & Hecla	Boston	23⅝	21⅛	22⅛	No.30, De.15 Q	0.50
Cerro de Pasco	New York	71⅛	67⅛	69⅛	Oc.13, No.1 Q	1.00
Chile Copper	New York	44⅛	41⅛	42⅞	De. 2, De. 30, Q	0.62½
Con. Coppermines	N. Y. Curb	6⅛	5¼	5⅜		
Copper Range	Boston	20	18	19⅜	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*54	*45	*50		
East Butte	Boston	2⅛	2	2	Dec. 1919	0.50
Granby Consol	New York	44⅞	41⅛	43	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	151⅛	138⅛	151⅛	Nov., 1920	0.50
Howe Sound	New York	46⅛	44⅛	45	De.31, Ja.16, Q	1.00
Inspiration Consol	New York	21⅛	20⅛	22⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	3	3	3		
Isle Royale	Boston	14⅛	14	14⅛	Se. 30, Oc. 15, Q	0.50
Kennecott	New York	88⅛	85	85⅞	De. 2, Ja.3 Q	1.25
Magma Copper	New York	56⅛	53⅛	55⅛	De.30, Ja.17 Q	0.75
Mason Valley	N. Y. Curb	1⅜	1⅛	1⅛		
Miami Copper	New York	19⅛	18	18⅛	No.1, No.15, Q	0.37½
Mohawk	Boston	50⅛	49	49	Oc.31, De. 1 Q	2.00
Montana-Idaho	Spokane	*42	*40	*42		
Mother Lode Coal	New York	3⅛	2⅛	2⅞	De.16, De.31	0.25
Nevada Consol	New York	20⅛	18⅛	18⅝	De.16, De.31 Q	0.37½
New Cornelia	Boston	30⅛	29	29	No.4, No.21 Q	0.50
Noranda	N. Y. Curb	24⅛	23⅛	23⅜		
North Butte	Boston	1⅛	1	1⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*99	*80	*99	Sept. 1926	0.03
Old Dominion	Boston	13⅜	12⅛	12⅛	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	136⅛	130⅛	130⅛	De.17, Ja.3 Q	1.50
Quincy	Boston	16⅛	15	15	March, 1920	1.00
Ray Consolidated	New York	...	...	15⅛	Ap.20, Ap. 30	0.25
St. Mary's Min. Ld.	Boston	31⅛	28	30	Fe.10, Ma.10	2.00
Seneca Copper	New York	3⅛	2⅞	3		
Shattuck-Denn	Boston Curb	*11⅛	*10⅛	*11		
Tenn. C. & C	New York	11⅛	10⅛	10⅞	No.30, De.15, Q	0.12½
United Verde Ex	N. Y. Curb	26⅛	25⅛	25⅛	Ja.4, Fe.1 Q	0.50
Utah Copper	New York	1.59	1.45⅛	1.48⅛	De.16, De.31 Q	1.50
Utah Metal & T	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*54	*50	*50		
NICKEL-COPPER						
Internat. Nickel	New York	87⅞	83⅛	85⅞	De.16, De.31 Q	0.50
Internat. Nickel pfd.	New York	...	...	110	Oc. 13, No. 1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*12⅜	*11⅛	*11⅛	June, 1927	0.005
National Lead	New York	129	126⅛	129	De. 16, De. 31 Q	1.25
National Lead pfd	New York	116⅛	116⅛	116⅛	Ja.13, Fe. 1 Q	1.50
St. Joseph Lead	New York	41⅞	40⅛	41⅞	Ma.9, Ma.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	7	6	6	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	41⅛	40⅛	40⅛	Nov., 1920	1.50
Butte C. & Z	New York	5	4⅛	4⅛	De. 9, De. 24	0.50
Butte & Superior	New York	10⅛	9⅞	9⅞	De.16, De.31 Q	0.50
Callahan Zn-Ld	New York	2	1⅞	1⅞	Dec., 1920	0.50
Consol. Lead&Zinc'A'	St. Louis	14⅛	14	14	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	23⅛	22	22⅛	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	...	...	117⅛	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	186⅛	184⅛	184⅛	No. 19, De. 10 X	2.00
United Zinc	N. Y. Curb	...	...	*55		
Yellow Pine	Los Angeles	*30	*30	*30	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1	1		
Argonaut	Toronto	*34	*32	*33		
Barry-Hollinger	Toronto	1.20	1.14	1.18		
Con.W.Dome L.new.	Toronto	*1⅝	*1⅛	*1⅛		
Cresson Consol. G	N. Y. Curb	2	1⅞	2	De. 31, Ja.10 Q	0.10
Dome Mines	New York	13⅛	12⅛	12⅛	De.30, Ja.20 Q	0.25
Golden Cycle	Colo.Springs	†1.74	†1.72	...	No.30, De.10 Q	0.04
Hollinger Consol	Toronto	18.50	17.30	18.05	No. 16, De. 2	0.10
Homestake Mining	New York	70	70	70	De.20, De.27 M	0.50
Kirkland Lake	Toronto	2.75	2.51	2.71		
Lake Shore	Toronto	27.15	26.60	27.05	De.1, De.15 QX	0.20
McIntyre-Porcupine	New York	27⅛	27⅛	27⅛	De.1, De.1 Q	0.10
Portland	Colo.Springs	†*25	†*20	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	...	...	48⅛	Au.22-29 Am.Sh.	1.52
Teck-Hughes	Toronto	10.65	10.20	10.65	Fe.1, X	0.15
Tom Reed	Los Angeles	*35⅛	*33	*33⅛	Dec., 1926	0.02
Tough-Oakes	Toronto	*77	*69	*75⅛		
United Eastern	N. Y. Curb	*47	*45	*45	July, 1924	0.05
Vipond Cons	Toronto	*75⅛	*71	*75⅛	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	6.55	6.20	6.25	Oc.17, No.1	0.05
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	17⅛	15⅛	16⅛		
Con. Cortes	N. Y. Curb	*18	*18	*18		
Dolores Esperanza	N. Y. Curb	*50	*36	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2⅛	2⅛	De. 15, Ja. 4	0.08
Tonopah Belmont	N. Y. Curb	1	1	1	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*11	*10	*11	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2	1⅛	2	Se.20, Oc.21	0.07½
West End Consol	N. Y. Curb	*5	*5	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*72	*67	*72	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	2.29	2.21	2.22	May, 1920	0.03
Castle-Trethewey	Toronto	*77	*75	*76		
Coniagas	Toronto	4.90	4.70	4.70	May, 1924	0.12½
Keeley	Toronto	*70⅛	*70	*70	Se.1, Se.15	0.08
Lorrain Trout Lake	Toronto	...	...	*60	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*20	*19	*20	Oct., 1920	0.03
Mining Corp. Can	Toronto.	4.00	3.80	3.90	Ja. 10, Ja. 25	1.50
Nipissing	N. Y. Curb.	6⅛	5⅛	5⅛	De. 31, Ja.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	3⅛	3⅛	3⅛	Ma. 25, Ap.4, QX	0.12½
Bingham Mines	Boston	57⅛	54⅛	55⅞	Ja. 21, Fe. 1 Q	0.95
BunkerHill&Sullivan	N. Y. Curb	4	144	144	No. 24, De. 5 X	0.75
Cardiff M. & M	Salt Lake	.3	*85	*85	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	.05	3.00	3.00	Nov., 1926 Q	0.10
Consti'nMng.&Mill'g	Spokane	*26	*25	*26		
Erupcion	Boston Curb	*55	*50	*50	De.17, Ja.2 Q	0.07½
Eureka Lily	Salt Lake	1.50	1.45	1.50		
Federal M. & S	New York	...	...	147½	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd.	New York	94	93	94	No. 12 De 15 Q	0.25
Hecla Mining	N. Y. Curb	18	17⅛	17⅛	No.15, De.15 Q	1.75
Highland-Surprise	Spokane	*13⅛	*12⅛	*13⅛		
Iron King Mining	Salt Lake	*57	*55	*57		
Keystone Mining	Salt Lake			*17	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*28⅛	*26⅛	*28⅛		
Lucky Tiger-Com	Kansas City	17.75	17.50	...	De.10, De. 20 X	0.12
Mammoth Mining	Salt Lake	2.05	2.00	2.05	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	3.75	3.65	3.75		
Park Utah	New York	10⅛	9⅛	9⅛	De. 15, Ja. 3 Q	0.20
Plutus Mining	Salt Lake	2.40	2.40	2.40	Oc. 25, No. 10 Q	0.10
San Rafael	San Fran.	*11⅛	*10⅛	*10⅛		
Silver King Coal	Salt Lake	10⅛	10⅛	10⅛	De. 24, Ja.2 X	0.35
Silversmith	Spokane	*21	*20	*20	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*49	*46	*49		
Sunshine M. Co	Spokane	1.25	1.10	1.20		
Tamarack-Custer	Spokane	*77	*64	*70	Sept., 1924	0.25
Tintic Standard	Salt Lake	13⅛	13⅛	13⅛	De.20, Ja.3 QX	0.40
Utah-Apex	Boston	5⅛	4⅞	5⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	58⅛	55⅛	58⅛	Se. 2, Oc. 1.	1.75
Cleveland-Cliffs Iron	Cleveland	105⅛	100	105	Oc. 15, Oc. 25 Q	1.00
Colorado Fuel & Iron	New York	83⅛	76⅛	78⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	24	22⅛	23⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	62⅜	56⅛	60⅜	No. 15, De. 1 Q	0.62½
Replogle Steel	New York	...	...	12⅛		
Republic I. & S	New York	...	...	59⅜	No. 15, De.1 Q	1.00
Republic I. & S. pfd.	New York	104⅛	104	104	De. 14, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	126	123	126	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	110	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	154⅞	150⅛	151⅛	No. 30, De. 30 Q	1.75
U. S. Steel, pfd	New York	141⅛	138⅛	140⅛	Oc.30, No. 29 Q	1.75
Virginia I. C. & C	New York	36	36	36	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	62⅛	62⅛	62⅛	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	...	...	24	Jn. 26, Jn.30	1.45
So. Am. G. & P. New.	N. Y. Curb	2⅛	2⅛	2⅛		
Alum. Co. of Amer	N. Y. Curb	123	120	122		
Alum. Co. of Amer.pf.	N. Y. Curb	105⅜	105⅛	105⅛	De. 15, Ja1 Q	1.50
Vanadium Corp	New York	65⅛	63⅛	63⅛	No. 1, No. 15 Q	0.75
Patino M. & E	New York	25⅞	23⅛	23⅛	Ap. 27, My. 5	1 sh.
ASBESTOS						
Asbestos Corp	Montreal	37⅛	32⅜	35	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	96	94⅛	95	De.31, Ja.16 Q	1.75
SULPHUR						
Freeport Texas	New York	104⅜	101⅞	103	Ja.14, Fe.1 QX	1.75
Texas Gulf	New York	78⅛	75⅛	77⅛	De. 1, De. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	48⅛	46⅛	46⅛	No.19, De.1 Q	0.75
Amer. Metal, pfd	New York	113⅛	111	111	No.19, De.1 Q	1.75
Amer. Sm. & Ref	New York	185⅛	181	182⅛	De.31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	133	131⅛	133	De.31, Ma.1 Q	1.75
Consol. M. & S	Montreal	268	256	258	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	139⅛	134⅛	138⅛	Ja.3, Ja. 17	1.00
U. S. Sm. R. & M	New York	47	43⅛	44⅛	Ja. 6, Ja. 14 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	54	52⅛	54	Ja. 6, J3 14 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED DEC. 20, 1927					Last Div.
Name	**High**	**Low**	**Last**	**Date**	**Amount**
Aramayo Mines (25 frs.)	74/4½	72/9	73/9	Nov., 1927	5 p.c. (†)
British Platinum (£1)	—/6	—/3	—/6	Feb., 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/4½	13/6	14/—	Jan., 1928	6 annas*
Bwana M'Kubwa (5s)	4/3	3/10½	4/—		
Camp Bird (2s)	4/6	2/1½	2/9		
El Oro (£1)	3/3	3/—	3/3	Nov., 1924	2½ p.c.*
Esperanza (10s)	—/3	—/3	—/3		
Frontino & Bolivia (£1)	13/9	13/—	13/9	Jan., 1928	5 p.c
Mexican Corpn. (£1)	9/3	8/1½	9/—		
Mexico Mines of El Oro (£1)	18/9	16/3	18/9	Dec., 1926	3½ p.c *
N'Changa Copper Mining	10/—	8/6	8/6		
Oroville Dredging (£1)	4/6	4/3	4/6	Dec., 1923	3½ p.c.
Ouro Preto (£1)	2/6	2/—	2/6	May, 1925	2½ p.c.
Rhodesian Congo Border (£1)	31/3	25/—	27/6		
St. John del Rey (£1)	10/3	9/6	10/—	May, 1927	3½ p.c
San Francisco Mines (10s)	28/3	27/9	28/3	July, 1927	15s.
Santa Gertrudis (£1)	17/1½	16/7½	17/—	Jan., 1928	7½ p.c
Selukwe (2s. 6d.)	9/1½	8/3	8/6	April, 1917	6¼ p.c
S. Amer. Copper (2s.)	1/3	—/4½	1/—	Nov., 1917	75 p.c
Tanganyika (£1)	67/6	63/9	65/7½	Aug., 1927	7½ p.c
Union Miniere du Haut-Katanga (Brussels)	11.000	10.425	11.000	July, 1927	182.63 (‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.